United States Department of Agriculture

USGS Glacier Peak Seismic Monitoring

Environmental Assessment

Forest Service Mt. Baker-Snoqualmie National Forest April 2020

For More Information Contact:
Todd Griffin, Forest Geologist
Mt. Baker-Snoqualmie National Forest
2930 Wetmore Ave., Suite 3A
(425) 783-6033

Responsible Official:
Jody L. Weil
Forest Supervisor
2930 Wetmore Ave., Suite 3A
Everett, WA 98201

Chapter 1 - Purpose and Need 1
1.1 Document Structure 1
1.2 Changes from Draft EA to Final EA 1
1.3 Introduction 2
1.4 Proposed Action 6
1.5 Purpose and Need for Action 6
1.6 Decision Framework 9
1.7 Tribal Consultation and Public Involvement 9
1.8 Issues 9
1.9 Relationship to Forest Plan 10
1.9.1 Land Allocations 11
1.10 Other Laws, Direction, and Analyses 12
1.11 Project Record 12
1.12 Maps and Acres Precision 12
Chapter 2 - Alternatives 14
2.1 Alternative A – No Action 14
2.2 Alternative B – Proposed Action 14
2.2.1 Project Sites 16
2.3 Project Design Criteria 21
2.4 Wilderness Act Consistency 23
2.5 Alternative Considered, but Eliminated from Detailed Study 27
Chapter 3 - Environmental Consequences 29
3.1 Hydrology, Soils, and Fisheries 29
3.1.1 Affected Environment 29
3.1.2 Environmental Consequences 31
3.2 Heritage 34
3.2.1 Affected Environment 34
3.2.2 Environmental Consequences 36
3.3 Plants 37
3.3.1 Affected Environment 37

3.3.2 Environmental Consequences 39
3.4 Recreation and Wilderness 42
3.4.1 Affected Environment 42
3.4.2 Environmental Consequences 43
3.5 Visual Quality 46
3.5.1 Affected Environment 46
3.5.2 Environmental Consequences 47
3.6 Wildlife 48
3.6.1 Affected Environment 48
3.6.2 Environmental Consequences 49
3.7 Other Environmental Components 68
3.7.1 Environmental Justice 68
3.7.2 Prime Forestland, Prime Farmland, Rangeland, etc. 68
3.7.3 Floodplains and Wetlands 69
3.7.4 Potential Conflicts with Plans and Policies of Other Jurisdictions 69
3.7.5 Wild and Scenic Rivers 69
Chapter 4 - Consultation and Coordination 70
4.1 Federal, State, and Local Agencies 70
4.2 Tribes 70
Chapter 5 - List of Preparers 72
Chapter 6 - References Cited 73
Appendix A: Volcanic Monitoring Equipment Details 78
Appendix B: Cumulative Effects Information 81

List of Figures

Figure 1 - Vicinity Map 4
Figure 2 - Proposed Action Map 5
Figure 3 - Land Allocation Map 13
Figure 4 - Example of co-located seismic and GPS units 15
Figure 5 - Proposed location for station GP01. View is looking west toward location as indicated by red circle 16

Figure 6 - Proposed location for station GP02. Red circle indicate approximate location of GPS and seismometer..... 17
Figure 7 - Proposed location for station GP03. Red circles indicate approximate locations of GPS and seismometer..... 18
Figure 8 - Proposed location for station GP04. USGS geologist standing at exact location of proposed seismic and GPS station. 19
Figure 9 - Proposed equipment upgrade at station GPW..... 20

List of Tables

Table 1 - Seismic Stations..... 3
Table 2 - Ground disturbance associated with USGS monitoring stations..... 24
Table 3 - Weight of materials to be transported to the monitoring stations 25
Table 4 - Attributes of watersheds effected 30
Table 5 - Biological Determinations for R6 Sensitive Species..... 40
Table 6 - Wildlife Resources Analyzed 51
Table 7 - Volcanic Monitoring Equipment..... 78
Table 8 - Past, Present, and Reasonably Foreseeable Future Actions 82

Chapter 1 - Purpose and Need

1.1 Document Structure

The Forest Service has prepared this Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. The Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the Proposed Action and alternatives. This document is organized into six chapters:

- *Chapter 1. Purpose and Need for Action*: This chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal.
- *Chapter 2. Alternatives, Including the Proposed Action*: This section provides a description of the no-action and the proposed action as well as other alternatives considered, but eliminated from detailed study. The description includes how the alternatives are consistent with the Wilderness Act of 1964. Also, this discussion includes project design criteria and mitigation measures that were added as a result of environmental analysis.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the existing environment that would be affected by the project and the environmental effects of implementing each alternative, including the Proposed Action. This analysis is organized alphabetically by resource area and includes other environmental components such as environmental justice.
- *Chapter 4. Consultation and Coordination*: This chapter provides a list of agencies and individuals consulted during the development of the environmental impact statement.
- *Chapter 5. List of Preparers*: Lists personnel involved in preparing this EA.
- *Chapter 6. References Cited*: Provides full citations for references cited in the analysis.
- *Appendices*: Provide more detailed information to support the analyses presented in the Environmental Assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the Project Record located at the Supervisors Office in Everett, Washington.

1.2 Changes from Draft EA to Final EA

There were two important changes from the draft EA to this final environmental assessment. These changes are in response to additional review and comments received from interested individuals and organizations. The changes are as follows:

1. Updated Minimum Requirements Analysis (MRA) – An updated MRA was completed which replaced the draft minimum requirements analysis from the draft EA. This updates the format to better compare the alternatives and to respond to public comments received during the scoping and comment periods. Some sections were removed and updated to

match the 2016 revision of the Minimum Requirements Decision Guide (available at: http://www.wilderness.net/MRA). The previous version was used as a basis for this document. Changes to the updated MRA include adding two alternatives, not analyzed in detail, and changing the preferred alternative from Alternative 4 (Personnel transported by helicopter to remote sites) to Alternative 3 (No personnel would be delivered to any site by motorized transport).

2. Proposed Action Alternative – To coincide with the recommended changes from the updated MRA the responsible official changed the preferred alternative from allowing personnel to fly to the three most remote sites to requiring all personnel to hike to each project site. No personnel would be delivered to any site by motorized transport. Equipment and materials would still be flown (sling load) to each project site.

1.3 Introduction

Glacier Peak is a potentially active volcano near popular recreation areas as well as the communities of Darrington, Oso, Arlington, Stanwood, Concrete, Sedro Woolley and Mt. Vernon. Glacier Peak, as a potentially active volcano, poses significant landslide, flood, channel migration, and earthquake hazards to wilderness users and nearby communities. Therefore, the Mt. Baker-Snoqualmie National Forest (Forest) is proposing to authorize a special use permit to the United States Geological Survey (USGS) for the installation and maintenance of five seismic monitoring stations throughout the Glacier Peak Wilderness. The stations would be constructed and maintained by the USGS – Cascade Volcano Observatory (USGS – CVO). Data gathered at these stations would be used to assess seismic activity and serve as a basis for communication regarding such activity and its related hazards to public safety. The USGS-CVO, and its partner the University of Washington's Pacific Northwest Seismic Network (PNSN), currently only operate one seismometer within the Glacier Peak Wilderness (GPW Station). This seismometer is an older analog system that does not meet current digital monitoring sensitivity.

Each station would consist of seismic and Global Positioning Satellite (GPS) units. The seismometers would detect background and elevated seismic activity at the volcano. Having sufficient seismometers strategically located on and around the volcano would allow for the detection and accurate location of small magnitude earthquakes and other seismic signals; analysis of which would be used to determine if a volcano is reawakening while magma is still several miles below the summit. Additionally, seismic data would aid in forecasting the likely onset time and style of eruptive activity.

The GPS equipment would measure subtle ground deformation of the volcano in response to magma entering or leaving the magma reservoir. Having multiple high precision receivers in-place on the volcano's flanks would allow the distance between receivers to be determined to within less than a centimeter prior to, during, and after an eruption. Additionally, GPS data can help determine whether local earthquakes are caused by intrusion of magma or are of tectonic origin, thus limiting false alarms of volcanic activity.

The project sites are all located within the Glacier Peak Wilderness in Snohomish County (figure 1). The legal descriptions of the seismic stations are shown in Table 1, a proposed action map (figure 2) highlights where each proposed station is located.

Table 1 - Seismic Stations

Station	Status	General Location	Township	Range	Section	Latitude	Longitude
GP01	New	Glacier Basin	30N	14E	29	48.066	-121.131
GP02	New; Co-locate with Miner's Ridge Lookout	Miners Ridge	31N	15E	7	48.207	-121.029
GP03	New; Co-locate with Lost Creek Ridge Repeater	Zilob Peak	30N	12E	5	48.122	-121.286
GP04	New	Glacier Peak East	30N	14E	11	48.111	-121.059
GPW	Existing; Equipment would be upgraded	Scimitar Glacier	30N	14E	8	48.118	-121.138

Figure 1 - Vicinity Map

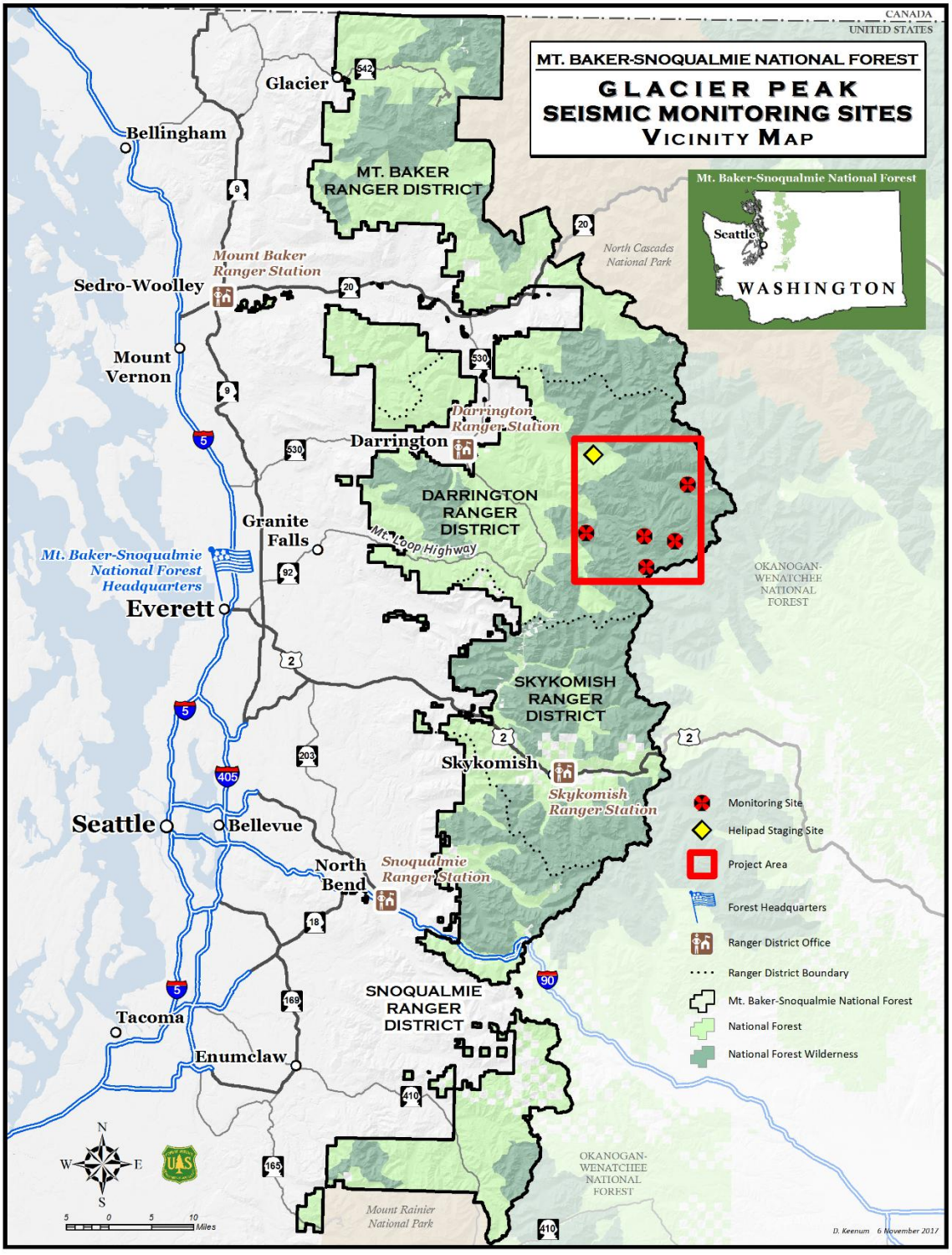
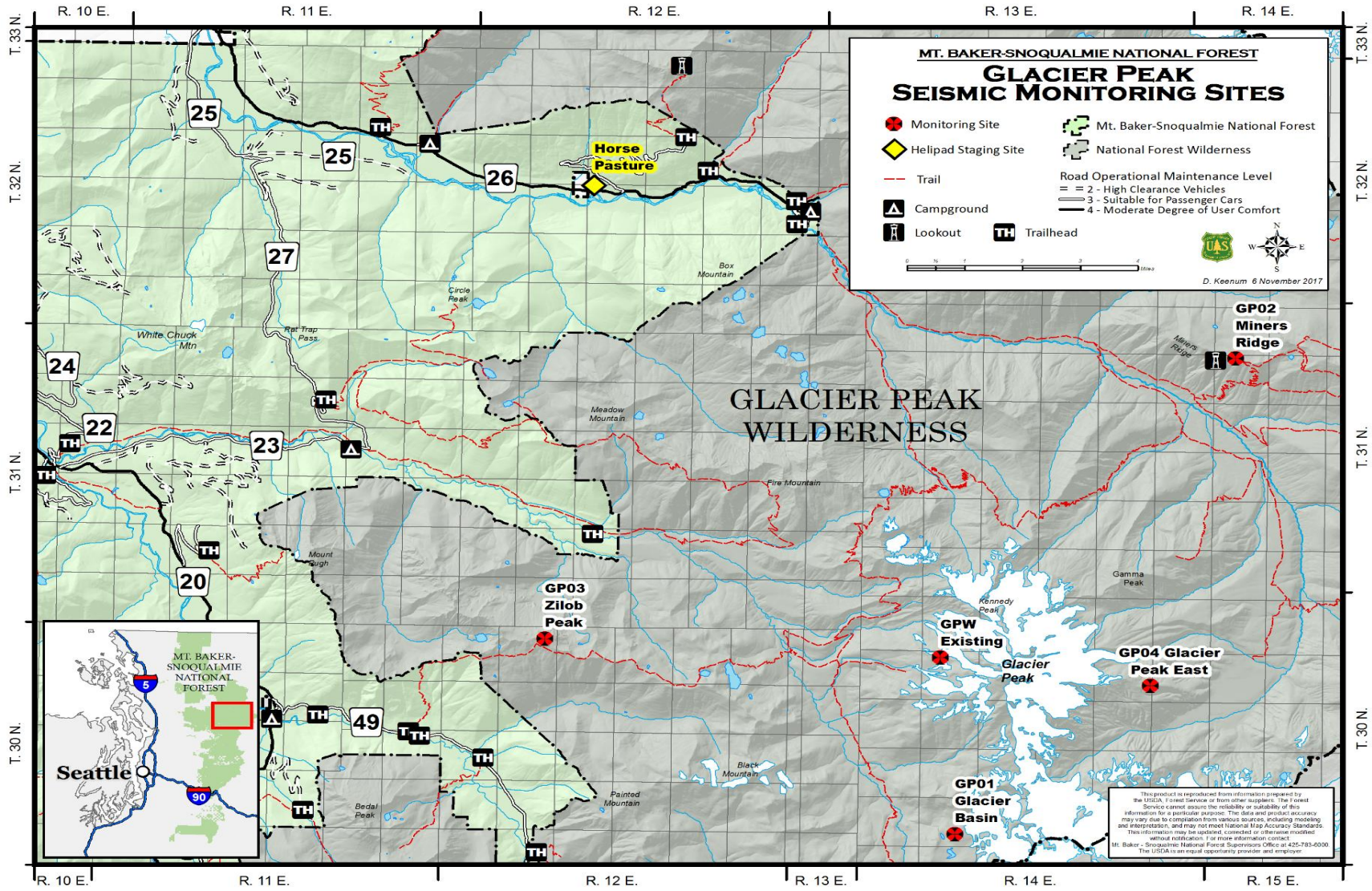


Figure 2 - Proposed Action Map



The Forest Service has prepared this environmental assessment to determine whether effects of the proposed activities may be significant enough to prepare an environmental impact statement. By preparing this environmental assessment, we are fulfilling agency policy and direction to comply with NEPA and other relevant Federal and State laws and regulations. For more details of the proposed action, see "Alternative B- Proposed Action" section of this document in Chapter 2.

In accordance with the National Environmental Policy Act (NEPA), an interdisciplinary (ID) team of resource specialists conducted analysis of the USGS Seismic Monitoring project. The Team performed the necessary research, conducted an assessment of the project's specific proposed action, sought public involvement, considered alternatives to the proposed action, and determined which mitigation measures and Best Management Practices (BMPs) would be required to protect resources.

This Environmental Assessment documents the potential environmental effects related to the Proposed Action. The EA gives sufficient detail to the public and the decision maker to provide an understanding of the environmental effects (consequences) of the alternatives, and to provide the decision maker with enough information to make a reasoned choice between alternatives. The decision maker will use the EA as the basis of the decision, which will be documented in a Decision Notice and Finding of No Significant Impact (FONSI).

1.4 Proposed Action

This project would issue a 20-year special use permit to USGS-CVO to install and maintain four new seismic and GPS monitoring stations surrounding Glacier Peak, and add equipment to an existing seismic station #GPW (permit #DAR43), as described in USGS-CVO's application. Sites GP02 and GP03 would be co-located at existing Forest Service administrative structures (Miner's Ridge Lookout and Lost Creek Ridge radio repeater). Sites GP01 and GP04 would be stand-alone stations. The equipment would consist of five co-located seismic and GPS units. Each co-located seismic and GPS unit would include a seismometer, 10 sealed batteries inside a small fiberglass enclosure, solar panels mounted on the enclosure, a GPS antenna and mast mounted in bedrock, and a data telemetry antenna mounted on the enclosure walls and lookout (GP02). Due to the bulk and weight of equipment a helicopter would transport all the equipment for each installation site. Field crews would hike to and from each site. A three person crew would camp overnight at each site. Installation is expected to take 3 days per site over a 2-3 week period, depending on weather conditions. For long-term maintenance of the sites, personnel would hike in to perform routine preventative maintenance. A helicopter may be required once every 3-5 years when transport of heavy gear over difficult terrain by foot is impractical or unsafe (i.e., replacement of batteries or failing equipment). For a more detailed description of the Proposed Action activities, refer to Alternative B – Proposed Action in Chapter 2.

1.5 Purpose and Need for Action

The USGS has the Federal responsibility to provide notifications and warnings for earthquakes, volcanoes, and landslides to the affected populace and civil authorities. To address the volcanic hazards posed by Glacier Peak to Wilderness users, as well as populations living in vulnerable areas, the USGS-CVO proposes installing and maintaining four new volcanic monitoring stations

and one systems upgrade at an existing station on the flanks of Glacier Peak, all located within the Glacier Peak Wilderness. The proposed monitoring stations are intended to provide USGS scientists with real-time early and adequate warnings of any changes in seismicity and ground deformation that may signal an increase in volcanic activity at Glacier Peak. The USGS designated Glacier Peak as a very high threat volcano in the 2005 report titled, "An Assessment of Volcanic Threat and Monitoring Capabilities in the United States: Framework for a National Volcanic Early Warning System" (Ewert et al. 2005).

With only one seismometer currently operating near Glacier Peak, the USGS-CVO has identified that there is a need for a more robust seismic monitoring of the mountain for the purposes of detection and accurate location of small magnitude earthquakes and other seismic signals.

As such, the primary purpose of the project is to fill gaps in the monitoring network at Glacier Peak. These stations enhance the ability to detect subtle signals beneath the volcano that indicate unrest, earlier and with greater confidence than current capabilities. Another purpose is to gather the data needed to help ensure the safety of both the adjacent communities, as well as recreationists using the wilderness, and the General Forest.

Early detection of unrest at Glacier Peak is particularly critical given the popularity of Glacier Peaks backcountry areas and the exposure of those users to near-field volcanic hazards (e.g., ejecta, pyroclastic flows, lahars) that can impact areas close to the volcano within 30 minutes or less of the start of an eruption or explosion. Recent eruptions in Alaska (Okmok, 2008; Larsen et al., 2009), Chile (Calbuco volcano, 2015; Van Eaton et al., 2016), and Japan (Ontake volcano, 2014; Kato et al., 2015) have illustrated that volcanoes can transition rapidly from a state of quiescence to eruption with as little as a few hours, or in rare cases even a few minutes of warning. If adequate systems are not in place and Glacier Peak were to wake up quickly, it is possible that warning signs of an impending eruption could be missed, putting the lives of Wilderness users and nearby residents in danger. The most common precursors to volcanic activity are surface deformation, increases in volcanic gasses emitted from a volcano, and increases in earthquakes. The proposed action by the USGS is designed to improve capabilities for detecting each of these types of precursory phenomena.

A 2008 USGS report (Moran et al., 2008) describes the scientific rationale for different types of monitoring equipment on volcanoes and the numbers of sensors required for adequate volcano monitoring. According to instrumentation recommendations from this report, Glacier Peak is significantly under-monitored relative to the risk it poses to Wilderness users and nearby communities.

There are two types of monitoring gaps at Glacier Peak:

1. The first gap is the ability to detect surface deformation of the Earth's surface. Surface deformation occurs as magma moves upwards towards the surface, into the magmatic system and pushes aside rock in the process. Magma-caused surface deformation can be very subtle (on the order of centimeters) and not visible to the naked eye or detectable from space, particularly in the early stages of unrest. Reliable detection of magma-caused deformation at Glacier Peak requires high-precision real-time continuously operating Global Positioning System (GPS) monitoring stations that are anchored into the ground. At present there is just one GPS station near Glacier Peak (GPW station at Scimitar Glacier). This single station is insufficient for reliable detection of deformation at Glacier Peak because deformation trends from a single station can't be relied upon, since they can be caused by non-magmatic processes such as antenna icing, diurnal

changes in temperature, and site instability. In addition, one station is insufficient for locating the deformation source, an important capability for assessing whether magma is rising and for assessing slope stability at the surface. The proposed action by the USGS would add 5 new GPS stations to the Glacier Peak monitoring network, which would significantly improve surface-deformation-monitoring capabilities at Glacier Peak.

2. The second gap is the ability to detect and precisely locate small earthquakes at Glacier Peak. For magma to rise to the surface, a pathway must be created; such a process involves breaking of rock, which in turn creates earthquakes, many of which are very small (magnitude < 1.0). Such seismicity is often the earliest form of unrest to occur before an eruption and detecting and precisely locating small earthquakes is critical for determining the timing and location of an eruption. Because Wilderness users are a constant presence at Glacier Peak, it is important that USGS scientists be able to detect small earthquakes and determine whether they are moving closer to the surface. At present there is only one seismic station in operation near Glacier Peak. Additional seismic stations are needed within 5-10 KM (3-6 miles) of the volcano to enable reliable detection and precise location of small earthquakes. The proposed action would add 4 new seismic stations (co-located with the 4 proposed GPS stations) and upgrade the existing seismic station at the GPW site. The USGS estimates that these new and upgraded stations would result in an 8-fold increase in the number of earthquakes that could be detected and precisely located at Glacier Peak.

Each of these monitoring gaps creates a significant blind spot in the present monitoring network's ability to detect early signs of unrest; these blind spots substantially increase the risk of Wilderness users and communities near Glacier Peak not receiving timely warnings. As one example, this is demonstrated by the onset of unrest associated with the 2004-2008 eruption of Mount St. Helens (MSH). Prior to the eruption there was a thirteen-station seismic network at MSH; however, there was just one operational continuous telemetered GPS station that was located 5 miles from the volcano (Lisowski et al., 2008). Therefore, when an earthquake swarm (mostly magnitude < 1.0 earthquakes) began on September 23, 2004, the seismic network was up to the task of detecting and locating events; however, due to the blind-spot created by not having a continuous GPS station close to MSH, USGS scientists at the CVO had no way of knowing whether there was ground deformation occurring inside the crater, which, if present, would be a strong indication that magma was moving towards the surface. As a result, CVO's initial assessment of the swarm, which was formally released to the public as an Information Statement at 1600 PDT on September 23 stated that, based on earthquake swarm characteristics alone, an eruption was not likely (Scott et al., 2008). However, when a continuous GPS station was installed in the crater on September 27, CVO had its first evidence that the crater floor was deforming at a substantial rate (LaHusen et al., 2008), making it clear that magma was involved. Had the crater GPS station been operating on September 23, it is very likely that CVO would have known several days earlier that the seismic swarm was a symptom of magma moving towards the surface. This in turn would have given Federal, State, and local officials several days of additional time to prepare for a possible eruption (the first explosion occurred October 1, just 8 days after the start of unrest). Were this same scenario to have occurred at Glacier Peak instead, several days of response time would have been lost due to the uncertainty of whether the swarm was caused by magma movement or other causes, placing wilderness users and local residents at increased risk of being in harm's way when the first explosions started to occur.

USGS-CVO has demonstrated that these monitoring stations cannot be located outside of wilderness and obtain adequate data (see section 2.5 for more information).

1.6 Decision Framework

The Mt. Baker-Snoqualmie National Forest Supervisor is the Responsible Official for this project. The Forest Supervisor will decide:

1. Whether to approve the Proposed Action, or
2. Approve an Alternative to the Proposed Action, and
3. What mitigation measures and monitoring requirements will be necessary as part of the decision.

The decision will be based on:

1. How well the selected alternative achieves the need,
2. How well the selected alternative protects the environment and addresses issues and concerns, and
3. How well the selected alternative complies with relevant policies, laws and regulations.

The Forest Supervisor will document her decision and rationale in a Decision Notice and Finding of No Significant Impact consistent with the requirements of Forest Service NEPA regulations (36 CFR 220.7(c)). The Decision Notice will determine consistency with the Forest Plan, as amended.

1.7 Tribal Consultation and Public Involvement

On May 14, 2015, the Forest Service sent consultation notices to local Tribes for this proposal. The Forest Service received one written comment from the Stillaguamish Tribe of Indians. In addition, the project was presented to the Sauk-Suiattle Tribal Council at a tribal government consultation and coordination meeting.

On May 15, 2015, the Forest Service sent scoping notices of this proposal to interested citizens, groups, industry, and agencies. The Forest Service received 12 written comments from interested citizens and organizations.

On July 11, 2018, the Forest Service sent consultation notices to local Tribes and requested comments on the draft environmental assessment. No comments were received from any of the local Tribes.

On July 16, 2018, the Forest Service sent request for comment notices of this proposal to interested citizens, groups, industry, and agencies. The Forest Service received 14 written comments from interested citizens and organizations, 11 supportive and 3 opposed to the project.

1.8 Issues

The Responsible Official reviewed comments received during all designated comment periods and the environmental effects identified by the ID Team assigned to the project. One purpose of

the review was to determine if there were any key issues to be addressed based on criteria for issues in the Council on Environmental Quality (CEQ) regulations at 40 CFR 1501.7.

The placement of monitoring equipment (manmade structures) within wilderness and the use of motorized equipment, including helicopters, for both the installation and battery replacement in the future would negatively affect wilderness character.

To address this issue, we considered the alternative of locating monitoring stations outside of wilderness. However, this alternative was eliminated from detailed study, as discussed in section 2.5. We also addressed this issue by minimizing the impacts to wilderness character as described in the description of the proposed action (section 2.2) and project design criteria/mitigation measures in section 2.3. Lastly, impacts to wilderness character are analyzed and disclosed in the recreation and wilderness section in Chapter 3. These impacts to wilderness character are summarized in section 2.4, Wilderness Act consistency.

1.9 Relationship to Forest Plan

This Environmental Assessment is tiered to the Final Environmental Impact Statement (FEIS) for the Mt. Baker-Snoqualmie Land and Resource Management Plan (USDA, 1990), as amended. Major plan amendments since 1990 include:

- *Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old-growth Forest Related Species Within the Range of the Northern Spotted Owl*, as adopted and modified by the April 1994 Record of Decision, which provides additional standards and guidelines (USDA FS & USDI BLM, 1994), and commonly known as the ROD, or the Northwest Forest Plan (NWFP)).
- *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and Other Mitigation Measure Standards and Guidelines* (USDA, USDI 2001).
- *Record of Decision to Clarify Provisions Relating to the Aquatic Conservation Strategy Amending Resource Management Plans* (USDA FS & USDI BLM, 2004)
- *Record of Decision for the Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants* (USDA, 2005).
- *Record of Decision for the Mt. Baker-Snoqualmie National Forest Invasive Plant Treatment (UDA, 2015).*

The 1994 ROD includes seven land allocations, which amend the allocations in the 1990 Forest Plan[1]. There is considerable overlap among some allocations, and more than one set of standards and guidelines may apply. Where the standards and guidelines of the 1990 Forest Plan are more restrictive or provide greater benefits to late-successional forest-related species than do those of the 1994 ROD, those existing standards and guidelines apply. The 1994 Forest Plan amendment also includes Forest-wide Standards and Guidelines, in addition to those in the 1990 Plan, and an

[1] The MBS National Forest has no Managed Late-Successional Reserve allocations.

Aquatic Conservation Strategy (ACS) designed to help improve the health of the aquatic ecosystem[2].

1.9.1 Land Allocations

The USGS Seismic Monitoring project area encompasses three land allocations (figure 3).

Northwest Forest Plan Land Allocations

Matrix: The Green Mountain Horse Pasture staging area is within the Matrix land allocation. This falls within federal lands outside of the following six categories: Congressionally Reserved Areas, Late-Successional Reserves, Managed Late-Successional Areas, Adaptive Management Areas, Riparian Reserves, and Withdrawn areas (Northwest Forest Plan, C-39).

Forest Plan Land Allocations

Wilderness: The stated goal for Congressionally designated wilderness in the forest plan is to "preserve and protect wilderness character". Allow for naturalness and provide opportunities for solitude, challenge, and inspiration. Within these constraints, and following a policy of non-degradation management, provide for recreational, scenic, educational, scientific, and historical uses." Wilderness land allocations are divided between five classes: 10A-Transition, 10B-Trailed, 10C-General Trailless, 10D-Dedicated Trailless, and 10E-Special Areas. Each class that contains a proposed project site is listed below.

Wilderness 10B (Trailed): Seismic stations GPW (Existing) and GP02 (Miners Ridge) are located within this land management allocation. This class includes all managed system trails extending beyond the Transition Class. This class extends at least 500 feet on either side of the trail but may be wider around lakes or heavily used areas. A moderate to high degree of opportunity exists for exploring and experiencing isolation, independence, closeness to nature, tranquility, and self-reliance through the application of no trace skills in a natural environment that offers a moderate to high degree of challenge and risk as one travels further from trailheads. The managed trail system may include trails classified as "more difficult," or "most difficult" and they shall receive maintenance activities as appropriate for the primary objective and difficulty levels. Visitors must be prepared for overnight camping, outdoor living, and changes in weather. A variety of user restrictions may be implemented to control use impacts as the need arises. (Land and Resource Management Plan, p. 4-210).

Wilderness 10D (Dedicated Trailless): Seismic stations GP01 (Glacier Basin), GP03 (Zilob Peak), and GP04 (Glacier Peak East) are located within this land management allocation. This class is managed forever trailless; obvious user-made travel ways are not permitted. Class may include way trails and routes not discernible as human related, the condition to be avoided is vegetation and soil loss along a continuous tread. The class may include popular attractions accessed only by cross-country travel. Human impact and influence is, by design, minimal therefore user restrictions may be necessary to insure that trailless experiences remain. Areas chosen for Dedicated Trailless should be of a size that will allow for a meaningful experience and can be reasonably protected for the experiences and remoteness identified. Generally the

[2] The ACS has four components: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration.

class is at least 2,000 to 3,000 acres in size and contain whole drainages or basins out of sight and sound of trials, or areas outside the wilderness. (Land and Resource Management Plan, p. 4-213).

Skagit Wild and Scenic River: The Green Mountain Horse Pasture staging area is located adjacent to the Suiattle River, in a river segment Congressionally designated as "Scenic River". The Scenic River classification emphasizes naturalness and opportunities for semi-private recreation, with attention to free-flowing unpolluted waters, limited road access, a shoreline and river corridor with limited development, free-ranging wildlife, and outstanding scenery. (Land and Resource Management Plan, p. 4-196).

1.10 Other Laws, Direction, and Analyses

A list with a description of applicable laws, direction, and analyses is available in the Project Record and incorporated by reference in this Environmental Assessment.

1.11 Project Record

This EA incorporates by reference the Project Record (40 CFR 1502.21) for the USGS Seismic Monitoring Project EA, documenting this NEPA process. The Project Record contains Specialist Reports and other technical documentation used to support the analysis and conclusions in this EA. These Specialist Reports address fish, plants, watershed resources, wildlife, heritage and treaty resources, wilderness, and recreation. Specialist Reports document the detailed analytical framework, methods, and conclusions employed to assess impacts on these resources.

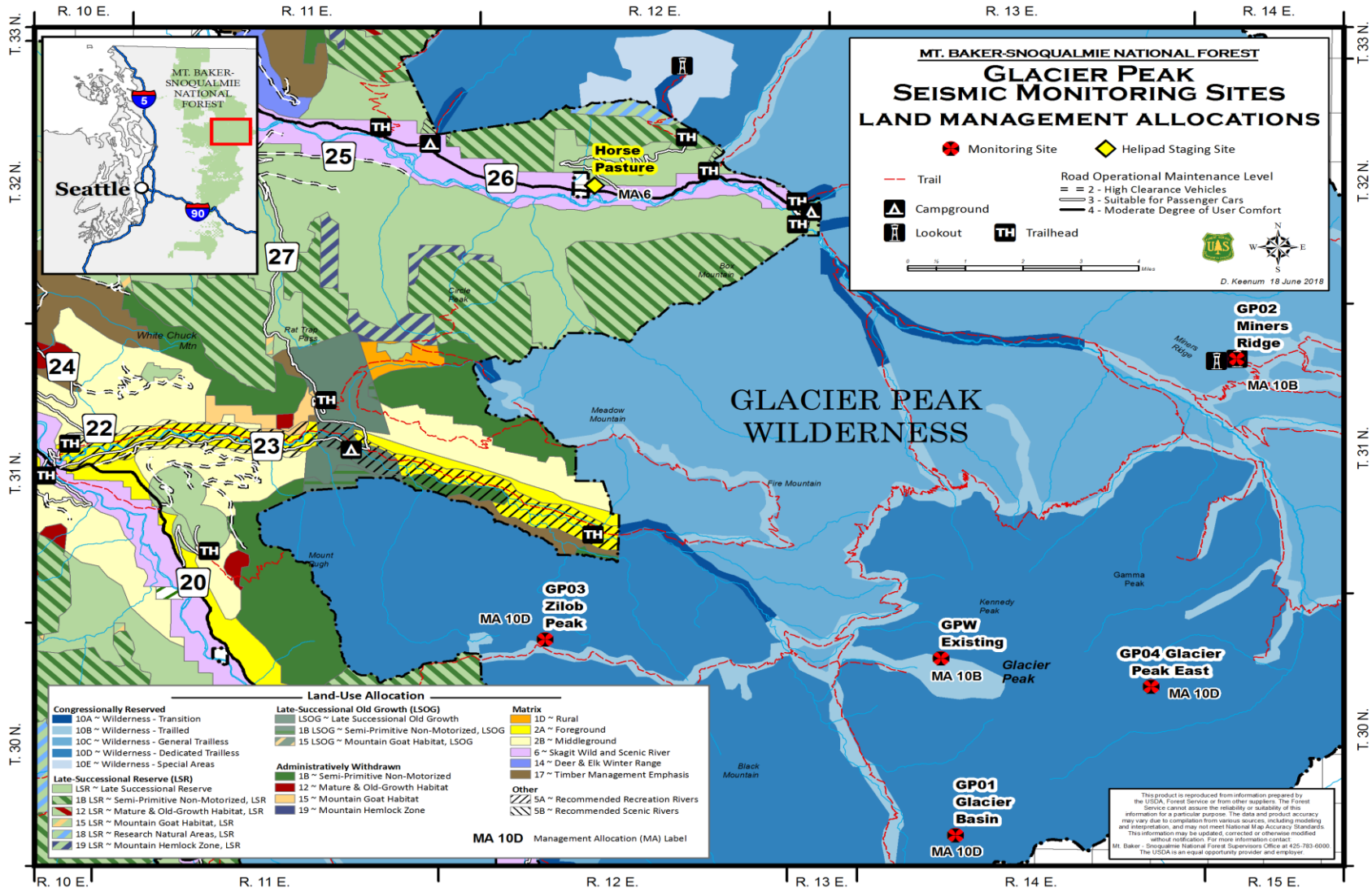
The reports also describe the affected environment, or baseline conditions, that provide background for the discussion of environmental consequences summarized in Chapter 3 of this EA.

Relying on Specialist Reports and the Project Record helps implement the CEQ Regulations' provision that agencies should reduce NEPA paperwork (40 CFR 1500.4). The objective is to furnish enough specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The Project Record is available for review at the Supervisors Office in Everett, Washington.

1.12 Maps and Acres Precision

All map boundaries and acre figures are approximations based on best available information at the time, and actual implementation may differ slightly to better reflect on-the ground conditions.

Figure 3 - Land Allocation Map



Chapter 2 - Alternatives

Two alternatives, Alternative A (No Action) and Alternative B (Proposed Action), were fully developed and are described in this chapter. The analyses of their environmental effects are disclosed in chapter 3. This chapter also includes relevant project design criteria, mitigation measures, and BMPs, along with a discussion of alternatives considered but eliminated from detailed study.

2.1 Alternative A – No Action

Under this alternative, no monitoring stations would be installed within 5 km to 10 km (3 to 6 miles) of the summit within the Glacier Peak Wilderness. Monitoring of volcanic activity at Glacier Peak would be conducted at existing monitoring stations located outside of wilderness and the one existing site (GPW) within wilderness. Earthquake hypocenters that get shallower with time as magma moves closer to the summit prior to an eruption may be impossible to detect in real time using monitoring stations outside of wilderness and the outdated analogue site within the wilderness. This alternative does not include any of the action components, previously listed.

This alternative has no effect on biological, physical, or cultural resources. All elements of the wilderness character would remain unchanged. Wilderness character elements include: untrammeled, undeveloped, natural, solitude or primitive and unconfined recreation, and other features of value.

Related to the safety of workers and visitors, since there would be no installation of monitoring stations in this alternative, there would be no hazard created by the tasks related to the installation. Wilderness visitors and the surrounding communities would not have an adequate early warning system for Glacier Peak's volcanic activity as outlined in *Instrumentation Recommendations for Volcano Monitoring at U.S. Volcanoes Under the National Volcano Early Warning System, Scientific Investigations Report 2008–5114* (Moran et al. 2008a).

Time constraints are analyzed in both the short-term and long-term. In the short-term, the only "time" constraint driving this project is the USGS's prioritization of getting instrumentation in place on the higher risk volcanoes. Under this alternative, USGS would not be able to provide the recommended monitoring level of volcanic monitoring on Glacier Peak and the Forest Service would not provide adequate warning for wilderness visitors and surrounding communities.

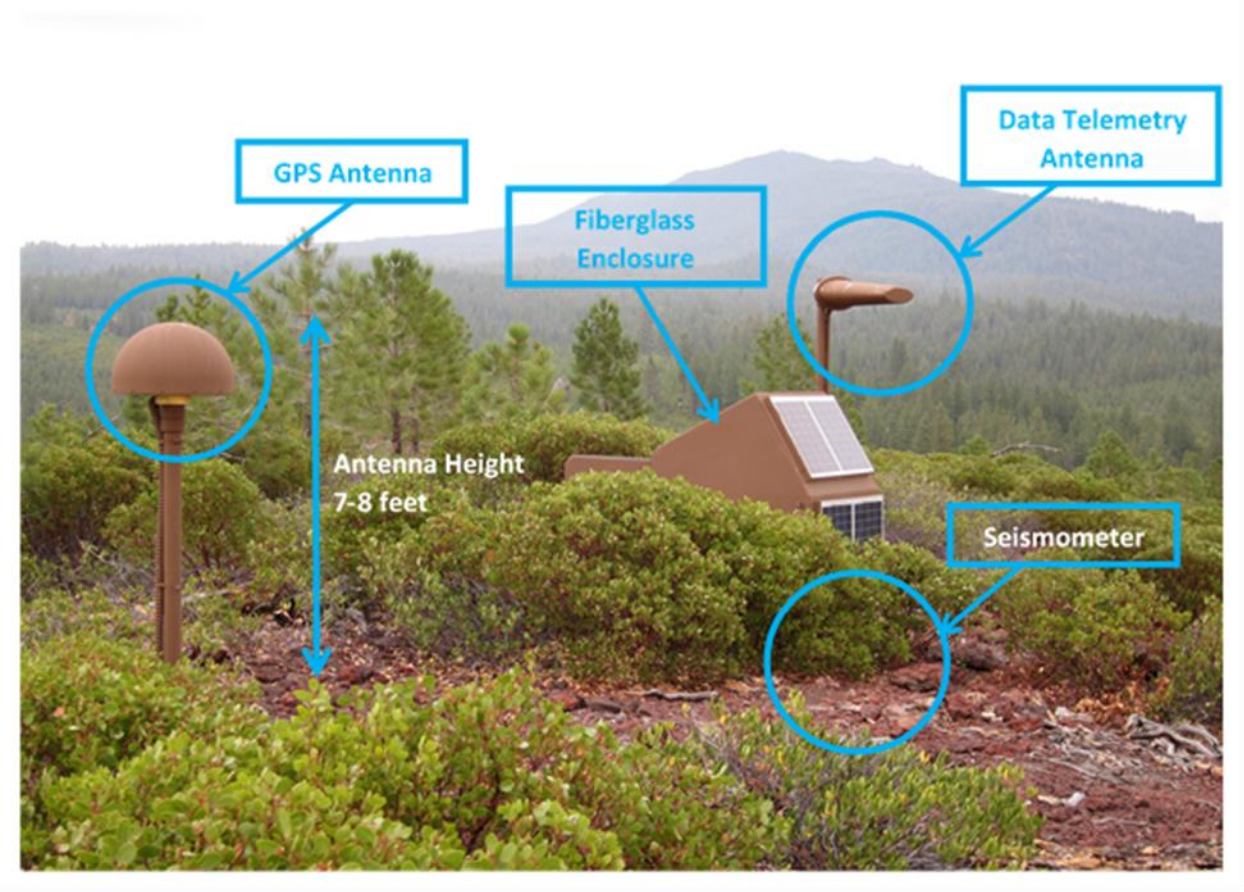
2.2 Alternative B – Proposed Action

Recent reports assessed the level of monitoring in the Cascades and concluded that most Cascade volcanoes are under-monitored, given the threats they pose to communities downstream and downwind (Ewert et al. 2005 and Moran et al. 2008). This includes the Glacier Peak volcano. It has been determined that the number and type of monitoring stations close to the summit are inadequate.

Based on this classification and existing circumstances, the USGS recommends that Glacier Peak be monitored at the highest of four monitoring levels. In this alternative, five Seismic/GPS

Stations with Fiberglass Enclosures would be installed in the Glacier Peak Wilderness. The five Seismic/GPS Fiberglass Enclosure Stations (figure 4) would be flown in using helicopter sling loads. Installation personnel would hike to each location. Batteries for the Seismic/GPS Fiberglass Enclosure Stations would be replaced by helicopter sling loads every 3 to 5 years. Maintenance personnel would hike to all sites for battery replacement. This use would be authorized for 20 years using a special use permit. See appendix A for details on the actual equipment.

Figure 4 - Example of co-located seismic and GPS units



For installation of the seismic/GPS fiberglass enclosures, there would be a total of 25 sling load flights: four sling-load flights to each of five sites to transport the seismic sensor, GPS unit, fiberglass enclosure, antenna, batteries, tools, and related materials; and one sling-load flight to remove tools and equipment from each site when installation is complete. Flight time for each sling-load flight over the wilderness is estimated to be 18 to 36 minutes. The use of battery powered hand tools would be authorized for the installation of the seismic/GPS enclosures.

Use of a helicopter would allow for the slinging of all gear and equipment to all locations in less than two days for each site. Removal of all excess materials and tools in less than one day after installations are complete at each site, with no unexpected weather delays. Total time to install each station would take no more than 3 days. By using a helicopter, the fiberglass enclosure could be prebuilt which would ensure the enclosure is constructed to a standard to eliminate

weather entry to the instruments. Work would be performed during a non-holiday weekday to minimize the number of encounters with helicopter that visitors would likely have in the wilderness.

2.2.1 Project Sites

GP01-Glacier Basin

The proposed site located SW of Glacier Peak and west of the White Chuck Glacier. The site consists of exposed bedrock surrounded by glacial till with some low lying grasses near the site. The exact site is located on a relatively small flat area away from any existing trails and would not be visible from the south (figure 5).

Minimal site modification would be needed at this location as there is little to no vegetation at the proposed site. The fiberglass enclosure would be placed directly on the ground and cemented in to the ground at the corners of the enclosure. The seismometer would be buried in the ground approximately 10 to 15 feet away from the enclosure in a hole dug by hand where soil conditions allow. It is critical the GPS antenna mast be well coupled to bedrock to best detect the very subtle ground deformation typical at volcanoes. The GPS antenna mast would be mounted to a 2 inch diameter galvanized pipe that would be installed in competent bedrock approximately 10 to 15 feet away from the enclosure. The mast would be installed in a 3 inch diameter hole drilled in to the bedrock approximately 3 feet deep using a battery or motorized rock drill. The pipe is inserted in to the hole and cemented into place with epoxy and mounted with the GPS antenna. The GPS antenna mast would extend 5 to 6 feet above the ground surface. All coax and seismic data cables running from the seismometer and GPS antenna would be sealed in aluminum conduit and placed in a hand dug trench running from both instruments to the equipment enclosure. Direct current power would be generated on-site to provide power to all the electronics by solar panels mounted to the enclosure and 10 sealed lead acid batteries within the enclosure. No noise or pollutants would be generated on-site.

Figure 5 - Proposed location for station GP01. View is looking west toward location as indicated by red circle.

GP02-Miners Ridge

The proposed site is located at the Miner's Ridge USFS Lookout tower located to the north of the Glacier Peak on Miners Ridge. The seismometer and GPS antenna mast would be installed in the ground adjacent to the tower, approximately 30 feet to the west of the tower. The area where the GPS and seismometer would be located consists of low lying grasses and shrubs (figure 6).

The seismometer would be buried in the ground approximately 30 feet away from the tower in a hole dug by hand where soil conditions allow. Given the lack of exposed bedrock at the surface, the GPS antenna would be installed directly into a hole in the ground and coupled to the ground with cement and rebar. To install the GPS antenna mast, a 3 foot diameter hole would be dug down to a depth of 4 feet by hand and the 2 inch galvanized mast would be placed in the center of the hole. Once the mast is installed, the hole would be filled with cement, rock, and metal rebar to better couple the mast to the ground. Once the cement dries, dirt and sand excavated from the hole are placed over the top of the cement and graded by hand to match the preconstruction ground surface. All coax and seismic data cables running from the seismometer and GPS antenna would be sealed in aluminum conduit and placed in a hand dug trench running from both instruments to a 5' x 3' x 3' foot aluminum enclosure that would be located at the base of the tower or inside of the tower. Once fully installed, all holes and trenches would be back filled by hand to match the preexisting ground surface. Direct current power would be provided to all equipment to be installed on-site utilizing solar panels and 10 sealed lead acid batteries.

Figure 6 - Proposed location for station GP02. Red circle indicate approximate location of GPS and seismometer.

GP03-Zilob Peak

The proposed site is located west of Glacier Peak near Zilob Peak. The USFS currently operates and maintains a radio repeater at this location. The site consists of several large granitic boulders and bedrock exposed at the surface surrounded by low lying grasses and shrubs (figure 7).

The seismometer would be buried in the ground approximately 15 feet away from the repeater enclosure in a hole dug by hand where soil conditions allow. It is critical the GPS antenna mast be well coupled to bedrock to best detect the very subtle ground deformation typical at volcanoes. The GPS antenna mast would be mounted to a 2 inch diameter galvanized pipe that would be installed in competent bedrock approximately 15 to 20 feet away from the enclosure. The mast would be installed into a 3 inch diameter hole drilled into bedrock approximately 3 feet deep using a battery or motorized rock drill. The pipe is inserted into the hole and cemented into place with epoxy and mounted with the GPS antenna. The GPS antenna mast would extend 5 to 6 feet above the ground surface. All coax and seismic data cables running from the seismometer and GPS antenna would be sealed in aluminum conduit and placed in a hand dug trench running from both instruments to the equipment enclosure. Direct current power would be generated on-site utilizing solar panels and rechargeable sealed lead acid batteries. The USGS proposes to add two additional solar panels onto the outside of the enclosure and 10 sealed lead acid batteries on the inside of the radio enclosure to provide power to the monitoring equipment.

The majority of the equipment would be located inside the existing USFS radio repeater enclosure. The USGS would place equipment so that it does not interfere with visitors experience or USFS operations at the tower.

Figure 7 - Proposed location for station GP03. Red circles indicate approximate locations of GPS and seismometer.

GP04-Glacier Peak East

The proposed site is located along a ridgeline west of Glacier Peak (figure 8). The site appears flat, dry, and dominated by sub/alpine meadow species. The soil in this area is an inceptisol described as loose and unstable by the Mt. Baker Forest Soil Resource Inventory atlas.

The fiberglass enclosure would be placed directly on the ground and cemented or bolted to bedrock at the corners. The seismometer would be buried in the ground approximately 10 to 15 feet away from the enclosure in a hole dug by hand where soil conditions allow. It is critical the GPS antenna mast be well coupled to bedrock to best detect the very subtle ground deformation typical at volcanoes. The GPS antenna mast would be mounted to a 2 inch diameter galvanized pipe that would be installed in competent bedrock approximately 10 to 15 feet away from the enclosure. The mast would be installed into a 3 inch diameter hole drilled into the bedrock approximately 3 feet deep using a battery or motorized rock drill. The pipe is inserted into the hole and cemented into place with epoxy and mounted with the GPS antenna. The GPS antenna mast would extend 5 to 6 feet above the ground surface. All coax and seismic data cables running from the seismometer and GPS antenna would be sealed in aluminum conduit and placed in a hand dug trench running from both instruments to the equipment enclosure. Direct current power would be generated on-site to provide power to all the electronics by solar panels mounted to the enclosure and 10 sealed lead acid batteries within the enclosure.

Figure 8 - Proposed location for station GP04. USGS geologist standing at exact location of proposed seismic and GPS station.

An additional instrument at this location would be a borehole tiltmeter. A tiltmeter measures the change in slope or “tilt” of the ground in response to inflation or deflation of the volcano. At times of heavy snow and icing, the tiltmeters provide valuable data about ground deformation when the GPS signal is degraded as a result of being incased in ice. Tiltmeters are installed into a 3 1/4 inch diameter hole drilled into the ground to a depth of 12 feet. The hole is cased with 3

inch diameter PVC plastic pipe and filled with sand to cover the bottom. The tiltmeter is then placed in the hole and additional sand is placed on top of the instrument. Depending on site conditions, the tiltmeter hole can be hand augured using a large soil hand auger, or in the case where bedrock or large boulders are located below the surface, a motorized electric powered core drill is required to drill out the hole. To be most effective, tiltmeters must be installed at a distance from the summit of volcano equal to one half of the source depth of the magma chamber. The typical source depth of magma chambers at Cascade Volcanoes is 7 km, so this corresponds to approximately 3 ½ km from the summit. The GP04 location is the preferred location for a tiltmeter on the east side of the volcano.

GPW- Scimitar Glacier

The GPW site is located on an isolated rocky outcrop on an east-west trending hogsback between the Scimitar and Sitkum glacial basins (figure 9). This includes fragmented young igneous rocks on the west face of Glacier Peak, much of which is perpetually covered in snow and ice.

The fiberglass enclosure would be placed directly on the ground and cemented or bolted to bedrock at the corners. The seismometer would be buried in the ground approximately 10 to 15 feet away from the enclosure in a hole dug by hand where soil conditions allow. It is critical the GPS antenna mast be well coupled to bedrock to best detect the very subtle ground deformation typical at volcanoes. The GPS antenna mast would be mounted to a 2 inch diameter galvanized pipe that would be installed in competent bedrock approximately 10 to 15 feet away from the enclosure. The mast would be installed into a 3 inch diameter hole drilled into the bedrock approximately 3 feet deep using a battery or motorized rock drill. The pipe is inserted into the hole and cemented into place with epoxy and mounted with the GPS antenna. The GPS antenna mast would extend 5 to 6 feet above the ground surface. All coax and seismic data cables running from the seismometer and GPS antenna would be sealed in aluminum conduit and placed in a hand dug trench running from both instruments to the equipment enclosure. Direct current power would be generated on-site to provide power to all the electronics by solar panels mounted to the enclosure and 10 sealed lead acid batteries within the enclosure.

Figure 9 - Proposed equipment upgrade at station GPW

2.3 Project Design Criteria

The following design criteria, standard management practices, BMPs, and requirements for the protection of resources are an integral part of the action alternative and are considered in the effects analysis in Chapter 3.

Botany

B-1: If any previously undiscovered TES or other rare or uncommon vascular plant, bryophyte, lichen, or fungus is discovered, before or during project implementation, halt work until a USFS botanist is consulted and necessary mitigation measures are enacted.
B-2: Treat known infestations of high priority invasive plants *before* ground disturbance begins. To be effective a lag time of 2 weeks is needed between the time of treatment and the time of ground disturbance.
B-3: Actions conducted or authorized by the FS that would operate outside the limits of the road prism require the cleaning of all equipment prior to entering NFS lands.
B-4: Suppliers must provide documentation indicating that the following products have been examined by a qualified inspector and deemed free of State listed noxious weeds: straw, mulch, gravel, rock, other fill, or seeds.
B-5: If weeds are present in the project area, all equipment and gear must be cleaned before leaving the project area to avoid spreading the infestation further.
B-6: If weeds are present in the project area, work from relatively weed-free areas into the infested area rather than vice versa.
B-7: For Washington State Class A and B designate noxious weeds: treat with the most effective method; after treatment has taken effect, cover the infestation with geotextile fabric to avoid spreading seed or roots remaining in the soil. Avoid disturbance to area. If disturbance cannot be avoided, treat infestation first, then wash equipment after working in the infested area before moving into an uninfested area.

Heritage and Cultural Resources

HC-1: If cultural items specified in the Native American Graves, Protection and Repatriation Act are discovered, or if human remains are determined to be Native American and non-forensic, the Forest Service will take jurisdiction and ensure that the Forest's NAGPRA protocol is followed, pursuant to the regulations at 43 CFR 10.
HC-2: If a previously unidentified cultural resource is discovered during implementation, the activity shall be stopped in the area of the find, and a reasonable effort to secure and protect the resource made. The Forest Heritage Specialist shall be notified and the Forest would fulfill its responsibilities in accordance with the Programmatic Agreement and other applicable regulations.

Recreation & Wilderness

RW-1: Flights on weekends and holidays should be avoided to reduce potential impacts to visitors.
RW-2: Post information about the project at trailheads leading to the staging or access to the installation sites.
RW-3: Post details, including timing, of the project on the Mt. Baker-Snoqualmie website.
RW-4: Limit trail and road closures as much as practicable (avoid multiple closures at once and limit duration of closures to only length of time necessary for operations).

RW-5: Limit operations to one site at a time so that only one location would be affected by helicopter disturbance at any given time.
RW-6: All installation debris needs to be removed from the sites.

Soil, Water, and Fisheries

SWF1 - All implementation would be completed when conditions are dry. At each location only 30 square feet would be affected; 25 square feet of this area would consist of a box being installed, concreted into place. All affected material from burying seismometer would be stabilized on site by refilling the hole with the same material.
SWF2 - Equipment staging and refueling activities for use of the helicopter would only occur at Green Mountain Pasture (NE ¼, NE ¼, Section 20, T32N, R12E, WM). This proposed staging area is located on existing roads and outside of the Glacier Peak Wilderness. Roads BMPs Road-9 and Road-10 apply (included below) as a staging area would be used and refueling activities may be needed for project implementation.
SWF3 - Ground disturbing activities under this special use permit would only occur for the construction and maintenance of the monitoring sites. All site specific BMPs within this document would be included in Special Use Permit authorizing USGS to implement and use the sites identified.
SWF4 - Establish a Spill Prevention Control and Containment Plan (SPCCP) and maintain a spill remediation kit on-site for any fuel stored on NFS lands in association with this project. Fuels stored on NFS lands shall be 100 feet or more from aquatic resources.
SWF5 - Refueling truck shall be kept and operated in a petroleum containment basin with 150% of the refueling trucks fuel capacity. All petroleum products would be secured in self-contained safety cans.

Visuals

V-1: Retain and keep in-tack trees, vegetation, soils, and rocks as much as reasonably possible, adjacent to resulting ground disturbed during installation of new seismic station elements.
V-2: Once new seismic station elements are installed and in-place, the replacement of disturbed and unearthed soil and rock should be graded and arranged in a way that the surface appears natural regarding grade, slope, and the clustering of rocks verses soil and vegetation.
V-3: All new seismic station elements that are to be installed adjacent to existing Forest Service administrative structures, such as; Miner's Ridge Lookout and Lost Creek Ridge radio repeater, should be painted to match the existing Forest Service administrative equipment. If this is not possible the new seismic station elements should be painted dark browns or blue-gray. Paint should have a matte finish.

Wildlife

WL-1: Heavy equipment and other activities generating noise above ambient levels within suitable nesting habitat for spotted owls and marbled murrelets would be scheduled for outside of the breeding season when not in conflict with other operational constraints.
WL-2: Heavy equipment and other activities generating noise above ambient levels and occurring between April 1 and September 15 would occur between two hours after sunrise to two hours before sunset.
WL-3: If raptor nest sites are found within the project area during implementation, activities will stop and a Forest Service Wildlife Biologist will be consulted. At the biologist's discretion protective buffers and/or seasonal operation restrictions (March 15th to August 3rd) may be assigned to newly located active nest sites.

WL-4: Garbage containing food and trash generated by workers will be handled as per wilderness guidelines or removed daily.

2.4 Wilderness Act Consistency

This project meets one purpose of the Wilderness Act as a scientific research project; the results would inform what measures are required to protect the safety of the wilderness users. It is important to have monitoring instrumentation in place before the start of volcanic unrest. As soon as unrest starts at Glacier Peak, a major question would be whether magma is rising and, if so, what sector of the volcano would be the likely point where magma breeches the surface. The goal of the proposed monitoring stations is to provide the data needed to significantly reduce the uncertainty. Answers to these questions would play an important role in determining mitigation efforts to protect the safety of wilderness users and the surrounding communities.

The risks to public safety from volcanic or earthquake activity are substantial and well-documented in the Pacific Northwest. Glacier Peak has experienced a number of eruptions since the end of the last ice age, including one eruption five times the size of Mount St. Helens. The volcanic eruption in 1980 at Mount St. Helens, on the Gifford Pinchot National Forest, killed 57 people and caused $1.1 billion in timber, agricultural, and public works damage, including the destruction of more than 200 homes, 185 miles of roads, and 27 bridges.

The proposed instrumentation was used on Mount St. Helens in the build up to the 2004 eruption. The buildup first started on September 23 as a result of the onset of a two day swarm of tiny volcano tectonic earthquakes. The swarm prompted an information release. On the September 25, earthquakes continued and increased in magnitude. By the next morning, there were a total of 10 earthquakes of increased magnitude, the most in a 24 hour period since the last dome building event at Mount St. Helens in 1986. Washington State Emergency Management Division was contacted about the activity and released a Notice of Volcanic Unrest indicating that seismic activity had surpassed normal background levels. The Gifford Pinchot National Forest closed the southern climbing routes on the volcano as well as other trails near the volcano. By September 29, seismicity intensified to about three seismic events per minute and the first explosion began on October 1. The total number of days between the first onset or uptick of small shallow earthquakes and the first explosion in the crater was only 8 days. The close proximity of the seismic monitoring stations to the center of the crater allowed scientists to identify the risk and land managers to make a decision to close access to Mount St. Helens in a timely manner, preventing potential injury or death.

As explained in section 2.5, these data cannot be collected outside the designated wilderness area. Filling these critical data gaps would provide the information needed for early warning and monitoring of seismic activity. This early warning and monitoring of seismic activity could save lives and reduce other adverse impacts by providing valuable advance notice of impending volcanic or earthquake activity, assuming that the information could be communicated to wilderness users in time to allow for evacuation or other protective measures. These monitoring stations would help protect wilderness users and the surrounding communities, as well as conducting scientific research on an active volcano. As such, the monitoring stations also would assist the Forest Service in administering the wilderness area for public use and enjoyment by ensuring that visitors remain safe while using the wilderness area.

Wilderness Character

The Wilderness Act requires that "each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area and shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character" as well as being "devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use" (Section 4(b)). Each quality of wilderness character is fully analyzed and discussed in section 3.4, as well as in the minimum requirements analysis[3]. The qualities of wilderness character include: untrammeled, natural, undeveloped, opportunities solitude or primitive unconfined recreation, and other features of value. The installation of the monitoring stations would have negative impact on some of the qualities of wilderness character (see section 3.4), however, the proposed safety improvements would have a positive impact to wilderness users. The qualities of undeveloped and opportunities for solitude and primitive and unconfined recreation would be impacted by this project. The scenic views (other features of value) from the proposed locations would be impacted, but not obstructed. Visitors might be able to see the instruments, but views of the summit of Glacier Peak, the adjacent mountains and the valleys below each site would remain visible.

The impacts to the wilderness area would be minimized as much as possible, including ground disturbance, motorized equipment, and visual quality impacts in order to preserve the wilderness character. The overall long-term disturbance associated with these sites is summarized in table 2. This project would impact approximately 150 square feet (less than 0.01 acre), which represents a very small fraction of the designated Glacier Peak Wilderness (566,322 acres).

Table 2 - Ground disturbance associated with USGS monitoring stations

Type of Enclosure	Structure Dimensions (Feet) (LxWxH)	Long-term Impact Area (square feet)
Fiberglass Enclosure	5x5x5	30 (Includes GPS mast and seismometer buried in the ground.)

Additional ground disturbance would occur during installation; however, no trees and very little vegetation would be removed in these work stations. It is anticipated that an area of 100 to 500 square feet in the immediate vicinity of the monitoring stations would be needed to serve as a temporary work space during installation. The impacts associated with these temporary work spaces would be short-term. Once installation is completed, no additional temporary work space would be needed for any of the maintenance visits.

Wilderness Act Prohibitions

The Wilderness Act prohibits motorized equipment, structures, installations, roads, commercial enterprises, aircraft landings, and mechanical transport "except as necessary to meet the minimum requirements for the administration of the area as wilderness" "including measures required in emergencies to meet the health and safety of persons within the area" (Section 4(c)). This project includes the following prohibited uses:

[3] The minimum requirements analysis is available on the project website at: http://www.fs.usda.gov/project/?project=46957.

- mechanical transport for installation (helicopter);
- motorized equipment for installation (battery-powered hand tools);
- installations (seismic and GPS stations).

Wilderness visitors and local communities are at risk from potential volcanic hazards such as pyroclastic flows and lahars during times of volcanic unrest. Unlike many other risks that wilderness visitors evaluate when traveling in wilderness, there is no way for wilderness visitors to independently evaluate the volcanic risk. Monitoring for volcanic hazards cannot be adequately accomplished without the use of installations, motorized equipment for installation, and mechanical transport. These prohibited uses are discussed and analyzed in more detail in the minimum requirements analysis.

This monitoring data cannot be collected from non-wilderness sites; owing to the small magnitude of volcanic earthquakes and the localized nature of pre-eruptive deformation, the data must be collected from within 5 kilometers (3 miles) of the summit of Glacier Peak. The previous section (1.4) and section 2.5 provides more information on why the data cannot be collected outside of the wilderness area.

The Forest Service Manual section 2326.1(5) states that motorized equipment and mechanical transport may be approved "to meet minimum needs for protection and administration of the area as wilderness." This is an essential activity needed to improve and protect public use and enjoyment of the wilderness area by ensuring that visitors remain safe during volcanic unrest. The monitoring network would allow an early warning system to inform wilderness users. This activity "is impossible to accomplish by non-motorized means because of such factors as time or season limitations, safety, or other material restrictions" (FSM 2326.1(5)(b)).

The monitoring stations are too heavy to carry to the site via non-motorized means, including pack animals. The overall weight of the materials needed for installing each monitoring site is approximately 1,900 pounds (see table 3). Non-motorized means of travel would be used for all maintenance work. After the initial installation, batteries for the Seismic/GPS Fiberglass Enclosure Stations would be replaced by helicopter sling loads.

Table 3 - Weight of materials to be transported to the monitoring stations

Materials	Weight in pounds
Fiberglass hut mounted with 4 solar panels to recharge the batteries	500
10 lead acid batteries, 70 pounds each	700
Instruments (dual frequency GPS, radio, coax, conduit, wire, seismic)	200
Solar panels	100
Concrete, including water	400
Total weight for installation	**1,900**

Minimum Requirements Analysis
The minimal requirements analysis (MRA) further discusses consistency with the Wilderness Act. These monitoring stations are the minimum requirements needed for the administration of the area. Both the MRA and section 2.5 outline that these monitoring stations cannot be located outside of wilderness and that five monitoring stations are the minimum number of stations. Moving the monitoring stations outside of wilderness or reducing the number of stations would not provide adequate scientific data and would not meet the projects purpose and need.

The MRA for installing and maintaining these stations has been completed and is available on the project website: http://www.fs.usda.gov/project/?project=46957. The minimum requirements analysis is designed to assist the responsible official for this project in making appropriate decisions in wilderness. The MRA considered four alternatives:

- No Action;
- Installation of five Seismic/GPS Fiberglass Enclosure Units using helicopter sling loads and battery-powered hand tools. Personnel transported by helicopter to all sites;
- Installation of five Seismic/GPS Fiberglass Enclosure Units using helicopter sling loads and battery-powered hand tools. No personnel would be delivered to any site by motorized transport;
- Installation of five Seismic/GPS Fiberglass Enclosure Units using helicopter sling loads and battery-powered hand tools. Personnel transported by helicopter to three remote sites (GPW, GP03, and GP04).

Four other alternatives were dropped from consideration in the MRA as they did not meet minimum requirements for the project.

- Installing Fewer Monitoring Stations - To detect very long period earthquakes generated by the volcano before and during an eruption, at least two broadband stations within 5 km of the summit are needed, and to accurately locate these events, at least four seismic stations are needed at distances within 5 km of the summit of the volcano.
- Seismic/GPS Fiberglass Station Pack-in Alternative - This alternative is not viable due to the inability of stock and personnel to transport the five 500-pound fiberglass enclosures. It is evaluated here to document its consideration as an alternative.
- Seismic and GPS Spider Unit with Motorized Equipment Transport - Spider units are only capable of large-scale ground deformation (sub-meter on a volcano or landslide). Units are not able to detect any long-term subtle ground deformation of the volcanic flanks. Spider units cannot collect and transmit data once buried by snow load. This alternative would not meet the minimum requirement for the project.
- No Motorized Transport or Battery Powered Hand Tools - An alternative that would implement this project without motorized equipment is not feasible due to the inability to deliver the equipment to the various sites due to access and size & weight of the equipment. In addition, it would also be impractical to implement the project without

using powered hand tools due to the need to drill and set the GPS receiver within solid rock (bedrock).

2.5 Alternative Considered, but Eliminated from Detailed Study

NEPA requires Federal agencies to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received as well as the preliminary effects analysis conducted by the interdisciplinary team suggested alternative methods for achieving the purpose and need. Some of these alternatives may be outside the scope of this analysis, may not meet the purpose and need for action, may not be reasonably feasible or viable, may be duplicative of the alternatives considered in detail, or may be determined to cause unnecessary environmental harm. The following alternatives were considered but eliminated from detailed study as part of this project.

Locating Monitoring Stations Outside of Wilderness

Wilderness Watch and others suggested that the Forest Service analyze an alternative that installs monitoring stations outside of designated wilderness areas. Under this alternative, any additional equipment needed to complement the site already located on the Forest (see figure 2) would be installed outside of the wilderness areas on National Forest System lands or other ownerships. However, this alternative would not provide the data needed to provide early warnings to wilderness users, other forest users, and the surrounding communities. This alternative was considered in the minimum requirements analysis but dropped as it did not meet minimum requirements for the project.

At its closest, the summit of Glacier Peak is 7.25 miles to the nearest edge of the wilderness. To accurately locate the source of seismic activity, a minimum of 4 seismic stations are needed. Since most volcanic earthquakes occur around the magma reservoir and are small (magnitude 1 and less), the 4 stations need to be located close to the volcano; particularly to locate earthquakes that are less than Magnitude 1. Many of the earthquakes accompanying the 2004 to 2008 Mt. St. Helens eruption did not even show up on stations less than 3 km from the crater. For shallow earthquakes, the ability to determine earthquake depth is extremely limited if there are an inadequate number of stations close to the summit and not directly over the magma reservoir. For example, a station at a distance of 10 km would not see much difference in the Primary (P) wave generated by earthquakes that are 1 km to 2 km deep, and a station that is 5 km from the hypocenter won't see much difference between earthquakes with 0 to 1 km in depth. In order to be able to detect earthquake hypocenters that get shallower with time as magma ascends closer to the summit prior to an eruption, more seismic monitoring stations need to be located as close to the volcano summit as possible. Additionally, very long period (VLP) earthquakes, earthquakes that occur at very low frequencies over a period of several seconds, which are typical at volcanoes, are generally not recorded at broadband seismic stations that are greater than 5 km away from the summit of the volcano. Thus, in order to detect VLPs generated by the volcano prior to and during an eruption, at least two broadband stations within 5 km are needed. To accurately locate VLP events, at least 5 broadband stations are needed at distances within 5 km of the summit of the volcano. Currently, there is only one seismic station located within 5 to 10 km of the summit. It is an older, analog device which does not meet current digital monitoring sensitivity.

This alternative was considered but eliminated from detailed study because it would not provide adequate scientific data and would not meet the purpose and need for action. The primary purpose for this project is "to fill gaps in the monitoring network at Glacier Peak." This alternative also would not meet the purpose of gathering the data needed to help ensure the safety of both the adjacent communities as well as recreationists using the wilderness and the Forest (see section 1.4).

No Motorized Equipment in Wilderness

Wilderness Watch suggested that the Forest Service analyze an alternative that would prohibit the use of motorized equipment within designated wilderness areas. Under this alternative, helicopter use would not be authorized to transport equipment and personnel to the seismic stations. However, it was determined in the MRA that this alternative would not be feasible due to the inability to deliver the equipment to the various sites due to access issues (remote locations) and the size and weight of the equipment.

The monitoring stations are too heavy to carry to the site(s) by non-motorized means. The overall weight of the materials needed for installing the monitoring sites is approximately 1,900 pounds (see table 3 above), and the weight of the replacement batteries is 700 pounds. This alternative was considered in the minimum requirements analysis but dropped as it did not meet minimum requirements for the project.

This alternative was considered but eliminated from detailed study because it would not be feasible to transport the equipment by non-motorized methods and would not meet the purpose and need for action. The primary purpose for this project is "to fill gaps in the monitoring network at Glacier Peak." This alternative also would not meet the purpose of gathering the data needed to help ensure the safety of both the adjacent communities as well as recreationists using the wilderness and the Forest (see section 1.4).

Chapter 3 - Environmental Consequences

This chapter discloses the environmental consequences of the No-Action Alternative (Alternative A) and the Proposed Action (Alternative B). It is organized alphabetically by resource area. The information under each resource area begins with a summary of the scope of the analysis and, in some cases, highlights of the affected environment. The results of the resource analysis are then outlined, starting with direct and indirect environmental effects, and then moving on to cumulative effects. Each resource-specific section ends with an assessment of Forest Plan consistency. The chapter concludes with a section on Other Environmental Components which includes required disclosures not otherwise discussed in chapter 3.

As noted in Chapter 1, Specialist Reports were prepared to fully document the site-specific analysis completed for the main resource areas of concern. These reports provide more detailed information regarding the analysis and include a description of the affected environment, which provides context for the description of impacts. Specialist Reports for Fisheries, Heritage and Treaty Reserved Rights, Plants, Recreation, Soils, Hydrology, and Wildlife are incorporated by reference and are available in the Project Record maintained at the Supervisors Office, Mt. Baker-Snoqualmie National Forest, Everett, WA.

3.1 Hydrology, Soils, and Fisheries

3.1.1 Affected Environment

Hydrology

The Proposed USGS Glacier Peak Seismic Monitoring project is located within the Skagit River Basin, the North Fork Sauk River, Upper White Chuck River, Lower White Chuck River, Headwaters Suiattle River, Miner Creek-Suiattle River, and Circle Creek-Suiattle River 6th field watersheds. Table 4 identifies the characteristics and beneficial uses for the affected watersheds. Beneficial uses are designated by the Washington State Department of Ecology and are listed in the Water Quality Standards for Surface Waters of the State of Washington (DOE 2012). There would be no wetlands, waterbodies, or streams affected by this project as the project would be located on ridge tops that are at least a mile from any surface water(s). Downslope from the proposed monitoring sites channels are typified by high gradient ephemeral streams that tend to be very rocky. These streams are the headwaters for the effected watersheds. These watersheds have been previously impacted by forest service trails. There are no impaired (303d) waterbodies within or affected by this proposed project.

Project activities with the Circle Creek-Suiattle River watershed would be limited to helicopter operations at the Green Mountain Horse Pasture. This location currently exists and the project does not propose any ground disturbing activities at this location. This site is located approximately ¼ mile from the Suiattle River. This watershed has been previously impacted by forest service roads and trails and past vegetation management projects.

Soils

All proposed monitoring sites in the project area are mapped as rock outcrop (could be areas of lose rock) in the Forest Soil Survey (USDA Forest Service 1970). Due to these areas being located at high elevations along ridge tops with steep side slopes soils (where they exist), soils

tend to be rocky, not very well developed, and consequently soil productivity here is very low. Elevations in the project area range from approximately 6,000 feet to 8,000 feet.

Table 4 - Attributes of watersheds effected

6th Field Watershed (Name/#)	Proposed Monitoring Site	Beneficial Uses	Total Watershed Acres
North Fork Sauk River 171100060102	GP03	Char Spawning/Rearing, Recreational Extraordinary Primary Contact, Domestic Water, Industrial Water, Agricultural Water, Stock Water, Wildlife Habitat, Harvesting, Commerce/Navigation, Boating, and Aesthetics	33,438
Upper White Chuck River 171100060104	GPW and GP01		24,617
Lower White Chuck River 171100060105	GP03		29,942
Headwaters Suiattle River 171100060201	GP04		24,941
Miners Creek-Suiattle River 171100060202	GP02		28,619
Circle Creek-Suiattle River 171100060303	Helipad Staging Area		25,363

Soil Quality Standards (SQS) do not apply to areas withdrawn for admin type uses and therefore will not be utilized for this proposal. The Forest Service's Soil Management Handbook (FSM 2551.3) states that "(s)oil management standards are not applied to administrative sites or dedicated use areas (such as roads, recreation sites)." (USDA Forest Service 2010)

Development under this project would be dedicated to constructing the new monitoring sites. Approximately 120 square feet (includes 4 new sites, approximately 30 square feet per site) of soil would be placed in a nonproductive state and would become unavailable for vegetative growth due to development of the new monitoring sites. However, there is very little administrative development in this area and since these proposed sites are all located within rock outcrop soil units where normal soil productivity is very low to non-existent.

There could be potential short-term increases in soil erosion and sediment moving off the project site. These increases would be prevented by the proper implementation of best management practices (BMPs) as described in Chapter 2. Sediment from the project is not anticipated to enter any streams due to prescribed BMPs and the distance proposed activities are located from any surface water. A small area (where monitoring sites are implemented) would have increased compaction and greater storm-water run-off/hydrologic response.

Fisheries

Designated critical habitat exists between one and three miles below the proposed monitoring sites for Puget Sound Chinook salmon, Puget Sound Bull Trout, and Puget Sound steelhead

respectively. There are no Forest Service Sensitive fish species on the Mt. Baker Snoqualmie National Forest. Management Indicator fish species (MIS) are present one to three miles downstream of the proposed monitoring sites.

No physical surveys were conducted in 1st order tributaries that may be present within the USGS Seismic Monitoring project area. Desktop analysis of known fish distribution and fish habitat indicate all fisheries observations occur between one and three miles downstream from the proposed monitoring sites. The streams, if present, in the project area are high gradient (12-20%), likely composed of colluvium, only seasonally present, and unlikely to provide suitable fish habitat.

3.1.2 Environmental Consequences

The analysis area for direct and indirect effects on the Hydrology and Fisheries resource is the affected 6th field watersheds. The analysis area for the direct and indirect effects on the Soils resource is the footprint of the proposed project.

Alternative A - No Action

The No Action Alternative proposes no change from the existing condition. The proposed new monitoring sites would not be installed.

Direct and Indirect Effects

No direct or indirect effects on fish or fish habitat, soils, and hydrology are anticipated from the No Action Alternative beyond those effects that currently occur. Current natural processes, conditions, and trends associated with fisheries, soils, and hydrology in the project area would continue, as outlined in the Affected Environment section above.

Alternative B - Proposed Action

Direct and Indirect Effects

The proposed action alternative has the potential to temporarily affect hydrology and soil resources; primarily, as a result of the burying of the proposed monitoring equipment and installation of the containers that would store the equipment. These activities have the potential to disturb soil. Soil displacement and sediment could cause an effect on watershed condition and aquatic habitat. Conservation measures incorporated into the project would be implemented to control erosion and sedimentation. The implementation of BMPs would avoid or minimize potential increases in sediment loads to streams during project implementation. Long term effects on hydrologic and soil resources are expected to be minor to non-existent due to this project being located along ridge tops and the distances from the proposed activities to any surface water.

A wide range of activity-specific BMPs are designed to minimize detrimental soil disturbance, protect water quality, and maintain physical stability and hydrologic connectivity of riparian and aquatic habitats (see section 3 of this report for a list of applicable BMPs). There is little potential for the proposed action to adversely affect the geomorphic, hydrologic, or riparian characteristics and aquatic habitats in the affected watershed. This is due to the use of activity-specific BMP’s and that this project would be located on the ridge tops.

The proposed action alternative would have no effect on fish or fish habitat due to the unsuitable nature of instream habitat of the ephemeral streams which precludes fish presence. Potential indirect effects include sediment discharge during ground disturbing activities within or adjacent

to ephemeral streams. However, such activities would only occur during generally dry weather conditions, are anticipated to be isolated from nearby aquatic resources, and would have BMP's implemented to further minimize potential discharge to aquatic resources. Therefore, no indirect effects to fish or fish habitat are anticipated from the proposed action alternative.

Effect Determinations

It is the determination that the USGS Glacier Peak Seismic Monitoring project will have no effect on Puget Sound Chinook salmon, Puget Sound Bull Trout, nor Puget Sound steelhead and their designated critical habitat. Further, there will not be any adverse effects to essential fish habitat (EFH) for Puget Sound Chinook, Pink, and Coho salmon.

It is also the determination that, based on direct, indirect, and cumulative effects analysis the USGS Glacier Peak Seismic Monitoring project would not contribute to a negative trend in viability of MIS fish species or their habitat on the Mt. Baker Snoqualmie National Forest.

ESA Consultation

Consultation with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service on the effects of the USGS Seismic Monitoring Project on federally listed fish species, designated critical habitats, and essential fish habitats, is not required. No consultation is needed when the effect determinations for federally listed species and designated critical habitats are "No Effect," and when the determination for EFH is "Would Not Adversely Affect."

Cumulative Effects

Appendix B lists past, present, and reasonably foreseeable future activities considered for possible cumulative effects on fish and fish habitat, soils, and hydrology with this project. The affected area for cumulative effects to the Hydrology and Fisheries resources is the affected 6th Field Watersheds. The affected area for cumulative effects to the Soils resource is the footprint affected by the proposed project.

Past and present activities within the analysis area include; road maintenance, trail construction and maintenance and past vegetation management projects. Future management activities in the project area include the continuation of trail and road maintenance.

Proper implementation of erosion control measures (BMPs) at the proposed monitoring sites would reduce the potential for water concentration and runoff. Implementing these BMPs would reduce the potential for sedimentation and erosion and for cumulative watershed effects.

Aquatic Conservation Strategy Objectives

New project NEPA decisions must be consistent with the wording regarding ACS consistency, including consistency with the nine ACS objectives, as ACS consistency is described in the 1994 NWFP ROD on page B-10. This excerpt is provided from page B-10:

> *"The intent is to ensure that a decision maker must find that the proposed management activity is consistent with the Aquatic Conservation Strategy objectives. The decision maker will use the results of watershed analysis to support the finding. In order to make the finding that a project or management action 'meets' or 'does not prevent attainment' of the Aquatic Conservation Strategy objectives, the analysis must include a description of the existing condition, a description of the range of natural variability of the important physical and biological components of a given watershed, and how the proposed project or management action maintains the existing condition or moves it within the range of natural variability." (1994 ROD, Attachment B, p. B-10)*

The nine ACS objectives are listed below along with how the Proposed Action meets them.

1. *Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.*

This project would maintain existing watershed-scale aquatic systems. This action would add monitoring equipment to these affected watersheds, however none of the proposed monitoring sites would be located within riparian reserves. Thus, the project effects would be localized and at such a small scale exclusively upland in nature that they would have no effect to watershed-scale aquatic systems.

2. *Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*

This project would maintain existing hydrologic connectivity within the effected watersheds. None of the sites occur in or adjacent to perennial or intermittent streams. BMPs would be implemented in part to not impact localized upland hydrologic conditions.

3. *Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

This project would maintain the existing physical integrity of aquatic banks and shorelines through the implementation of BMPs during construction activities and that no project sites would affect shorelines, banks, or bottom configurations.

4. *Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

This project would maintain existing water quality by controlling the amount of sediment delivered to streams as a result of sites being located in upland areas and implementing BMPs. All construction activities would maintain current flow patterns through the implementation of BMPs and the distance proposed monitoring sites are located from any surface water. This project would not negatively impact designated beneficial uses of water.

5. *Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate and character of sediment input, storage, and transport.*

This project would maintain the existing sediment regime by implementing BMPs to reduce the potential for erosion to occur off site.

6. *Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.*

This project would maintain existing in-stream flows as none of the sites nor construction will occur in Riparian Reserves, nor will impact enough area to any measurable effect on stream flows.

7. *Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.*

This project would maintain the existing timing, variability, and duration of floodplain and wetland inundation by maintaining hydrologic connectivity in riparian areas. Site location does not occur in Riparian Reserves and associated floodplains.

8. *Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

This project would maintain the existing composition and diversity of plant communities in riparian areas as this project would have no effect to riparian areas.

9. *Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

This project would maintain the existing composition and diversity of plant communities in riparian areas. This project would not affect riparian areas.

Forest Plan Consistency

All Alternatives would meet the Forest Plan standards and guidelines for fish, and would therefore be consistent with the Forest Plan (USDA, 1990), as amended (USDA FS & USDI BLM, 1994). The Hydrology, Soils, and Fisheries Specialist Report, located in the Project Record, lists all applicable Forest Plan Standards and Guidelines relevant to the USGS Seismic Monitoring Project.

Specialist Report

This EA hereby incorporates by reference the Hydrology, Soil, and Fisheries Specialist Report (40 CFR 1502.21). The Hydrology, Soil, and Fisheries Specialist Report is located in the Project Record and contains the detailed data, tables, maps, Affected Environment, analysis, references, reports, and technical documentation that the project ID Team's Fish Biologist and Hydrologist relied upon to reach the conclusions in this section of the EA.

3.2 Heritage

3.2.1 Affected Environment

The project area is in the traditional territory of the Sauk-Suiattle Indians. Since pre-treaty times, the Sauk-Suiattle people have continuously resided in the drainages of the Sauk and Suiattle Rivers (Hollenbeck 1987). Many of the larger semi-permanent villages from the extensive pre-contact era were located in the lower valleys, but the high peaks, ridges, meadows, and lakes were used throughout the warmer seasons when the snow was clear. The remains of these earlier uses, however, are scarce and often obscured by the dense Western Washington

rainforest. Nevertheless, the area is of special significance to the history and cultural identity of the Sauk-Suiattle Tribe.

The project area includes four new sites and one existing site in isolated locations around Glacier Peak. The physical environment of each location is described below:

GPW- Existing Monitor Station

The GPW sensor is on an isolated rocky outcrop on an east-west trending hogback between the Scimitar and Sitkum glacial basins. The station is located within the soil unit 958 as described by the Mt. Baker Forest Soil Resource Inventory atlas. This includes fragmented young igneous rocks on the west face of Glacier Peak, much of which is perpetually covered in snow and ice. The current Natural Resources Conservation Service (NRCS) soil atlas and aerial imagery verify that the terrain is a scoured rocky outcrop. The site has no archaeological potential.

GP01- Whitechuck Glacier

The GP01 sensor would be located on a hilltop among bedrock and associated till of the Whitechuck Glacier. Like the GPW existing station, the landform is isolated and barren. It is located within soil class 808 as described by the Mt. Baker Forest Soil Resource Inventory atlas. This includes rock outcrops, steep slopes, debris, and rockfall, much of which is perpetually covered in snow and ice. The current NRCS soil atlas and aerial imagery verify that this terrain is a barren outcrop on the periphery of the scoured icefields. The site has no archaeological potential.

GP02- Miners Ridge

The GP02 sensor would be located on Miners Ridge, co-located with the existing fire lookout. It is located within soil class 805 as described by the Mt. Baker Forest Soil Resource Inventory atlas. The current NRCS soil atlas and aerial imagery support the classification. The site is located at the peak of a knoll on a steep ridge overlooking the Suiattle River. While the surrounding slopes are heavily forested, the crest of the ridge is meadow with thin fragile soils and rocky outcrops. The lookout is located at the disturbed foot print of a previous lookout, further limiting the potential for subsurface archaeological deposits.

The Miners Ridge Lookout was constructed in 1936 following a previous lookout constructed around 1930. Prior to this, at least as far back as 1928, the site was a lookout camp comprised of little more than a tent and fire finder. The current lookout is listed on the National Register of Historic Places.

GP03- Lost Creek Ridge

The GP03 sensor would be located at Lost Creek Ridge, west of Glacier Peak. The site is a knob bounded on the east by a small cirque, and on the south by the steep incline of the Lost Creek valley. The 1931 Mt Baker forest map shows a trail along this ridge from Round Lake to the Kennedy Hot Springs. The trail was no longer contiguous by 1937 and is now bypassed by a modern trail farther down the slope.

Like the GPW existing station and GP01, the landform is located within soil class 808 as described by the Mt. Baker Forest Soil Resource Inventory atlas. However, the current NRCS soil atlas and aerial imagery do not verify that this terrain is bleak and scoured as the previous locations. It appears to be a seasonally accessible tundra among a series of hospitable

alpine lakes. Nevertheless, the soil is poorly developed, shallow, and unlikely to retain significant archaeological data. However, the proposed location may have been along a transient route used by both pre-contact and contact-era travelers between the more desirable landforms in the area. The proposed site currently hosts a radio repeater.

GP04- Glacier Peak East

The GP04 sensor would be located on a steep ridge on the east side of Glacier Peak. It overlooks the Chocolate Glacier basin to the north but is precariously perched on the thin ridge over a tributary basin which drains heavy snowmelt and perennial icefields into Chocolate Creek. The soil in this area is an inceptisol described as loose and unstable by the Mt. Baker Forest Soil Resource Inventory atlas. The location has no archaeological potential.

Previous Cultural Resource Surveys

None of the project locations had previous cultural resource surveys according to MBS records; however, the two sites of highest site potential have been visited in the past. The Lost Creek Ridge monitor would be co-located at an existing radio antenna, and the Miners Ridge site would be located at the existing lookout tower.

Previously Recorded Cultural Resources

The Miners Ridge monitor would be co-located at the Miner's Ridge Lookout, which is listed on the National Register of Historic Places (NHRP). The other four locations have no previously recorded cultural resources.

3.2.2 Environmental Consequences

Alternative A - No Action

The No Action Alternative proposes no change from the existing condition. The proposed new monitoring sites would not be installed.

No direct or indirect effects on heritage or cultural resources are anticipated from the No Action Alternative beyond those effects that currently occur. Current conditions and trends associated with heritage and cultural resources in the project area would continue, as outlined in the Affected Environment section above.

Alternative B - Proposed Action

Direct and Indirect Effects

The direct effects of the permit would stem from the installation of the monitor stations (as opposed to the continued operation and maintenance of the equipment.) The installation of the monitors could pose a risk to archaeological deposits given that they must be anchored to bedrock. Excavation of soil to reach bedrock would disturb buried materials and destroy provenience information. However, as soil is either not present or soil conditions are not conducive to the preservation of significant archaeological information, this risk is considered negligible.

The sensor proposed for the Miners Ridge Lookout poses another risk, as the site is listed on the NRHP. The co-location of the sensor equipment at the lookout has the potential to affect the historical integrity of the lookout. Alterations to historical buildings can detract from the character and integrity to a degree that they are considered "adverse effects," requiring mitigation through consultation with the State Historic Preservation Office (SHPO). The installation at Miner's Ridge and attachment of the telemetry antenna to the lookout was

determined to present no adverse effects to the historic property. State Historic Preservation Office concurred with this determination on May 1, 2017.

While the operation of the equipment poses no threat to cultural resources, the presence of the equipment poses a slight risk as a visual detraction if there were significant sites or traditional cultural properties (TCPs) within the vicinity. The equipment is relatively small and specifically colored to blend into the environment, reducing this risk. Nevertheless, the co-location of the ground equipment at the Miners Ridge lookout will indirectly affect the integrity of the building's setting. The effects is not to the extent that it would be considered "adverse." There were no other significant sites or TCPs identified near the proposed locations.

Cumulative Effects

Archaeological sites are non-renewable resources that are being lost with an increasing frequency to alteration or destruction. However, current projects and those in the foreseeable future are given the same consideration per cultural resource laws in regards to potential adverse effects. No projects are planned or predicted within the project area that would result in adverse effects to historic properties.

Forest Plan Consistency

All Alternatives would meet the Forest Plan standards and guidelines for Heritage, and would therefore be consistent with the Forest Plan (USDA, 1990), as amended (USDA FS & USDI BLM, 1994). The Heritage Resources Specialist Report, located in the Project Record, lists applicable Forest Plan Standards and Guidelines relevant to the USGS Seismic Monitoring Project. Implementation of the required mitigation measures would be consistent with all heritage-related Forest Plan Standards and Guidelines.

Specialist Report

This EA hereby incorporates by reference the Heritage Resources Specialist Report (40 CFR 1502.21). The Heritage Resources Specialist Report is located in the Project Record and contains the detailed data, analysis, references, reports, and technical documentation that the project ID Team's Archeologist relied upon to reach the conclusions in this section of the EA.

3.3 Plants

3.3.1 Affected Environment

The project sites are located within the Northern Cascades Physiographic Province (Franklin & Dyrness, 1973) on the Darrington Ranger District of the Mt. Baker-Snoqualmie National Forest.

Field surveys were not conducted for this project. Photographs of the proposed project monitoring stations, located in the project record, were examined during the pre-field review process for this analysis to assess potential habitat for listed subalpine and alpine species within the range of Mt. Baker-Snoqualmie National Forest. The photographs show the conditions in and around each proposed monitoring station as of December 2016. The photographs are not of high enough quality or taken at a time of year to accurately identify all species present. The results of pre-field review for each area are summarized below.

GP01 - Glacier Basin

Site GP01 is located at approximately 6,760-feet in elevation, west of the White Chuck Glacier, south of Glacier Peak. The site appears to be a shallow, rocky bench dominated by cryptograms and sparsely vegetated by alpine heaths, thus suitable habitat for *Erigeron salishii (*Salish fleabane*), Eurybia merita (*Arctic aster*), Campanula lasiocarpa (*Alaska harebell*), Pellaea breweri (*Brewer's cliff-brake*), Oxytropis monticola (*yellowflower locoweed*),* and *Kalmia procumbens (*alpine azalea*).* Short tufts of an upland sedge or grass are present, thus the site is also suitable habitat for *Carex scirpoidea* ssp. *Scirpoidea (*Canadian single-spike sedge*), Poa nervosa (*Wheeler bluegrass*),* and *Luzula arcuata ssp. Unalaschcensis (*Alaska curved woodbrush*).*

GP02 - Miners Ridge

Site GP02 is located at approximately 6,210-feet in elevation, north of Glacier Peak. The site appears highly disturbed. Bare patches of ground are visible where trampling or dispersed recreation has likely killed vegetation. The site appears to be flat, dry, and dominated by heaths. Conifers are scattered along the perimeter of the ridgeline, and small saplings scattered throughout the heath. A Pine species can be seen in a few of the photos provided, in addition to numerous small Pine saplings, maybe under 2-feet tall, with visible yellowing needles. Both *Pinus contorta* and a five-needle pine occur atop the ridge. In addition to *Pinus albicaulis* (whitebark pine), the site is suitable habitat for *Botrychium ascendens (*upward-lobed moonwort*), Poa nervosa, Campanula lasiocarpa, Kalmia procumbens,* and *Luzula arcuata* ssp. *unalaschcensis*.

GP03 - Zilob Peak

Site GP03 is located at approximately 7,280-feet in elevation, along a ridgeline west of Glacier Peak. Although the station would be co-located with the Lost Creek Ridge Repeater, the site does not appear to be highly disturbed. The site appears flat, dry, and dominated by heaths. Conifers are scattered along the perimeter of the ridgeline. There are large, flat boulders scattered around the site. The site is suitable habitat for *Poa nervosa, Campanula lasiocarpa, Kalmia procumbens,* and *Luzula arcuata* ssp. *unalaschcensis*.

GP04 - Glacier Peak East

Site GP04 is located at approximately 7,680-feet in elevation along a ridgeline west of Glacier Peak. The site appears flat, dry, and dominated by sub/alpine meadow species such as *Antennaria* spp. (pussytoes), *Castilleja* spp. (Indian paintbrush), and *Pedicularis* spp. (lousewort) interspersed with patches of heaths. Wet moist pockets are possible at this site based on the presence of *Veratrum viride (*green false hellebore*).* The site is suitable habitat for *Poa nervosa, Campanula lasiocarpa, Kalmia procumbens, Gentiana glauca (*glaucous gentian*), Packera porter (*Porter's butterweed*),* and *Luzula arcuata* ssp. *unalaschcensis*.

GPW

Site GPW is located at approximately 6,520-feet west of Glacier Peak, along a ridgeline near the Scimitar Glacier. The site appears rocky, with little vascular plant vegetation cover. The site is suitable habitat for *Campanula lasiocarpa, Carex scirpoidea* ssp. *scirpoidea, Erigeron salishii, Eurybia merita, Luzula arcuata* spp. *unalaschcensis, Oxytropis monticola, Packera porteri, Pellaea breweri,* and *Poa nervosa*.

Green Mountain Horse Pasture

The horse pasture is located off the Suiattle River Road at approximately 1,000-feet in elevation. The site is highly disturbed and primarily used as a helipad and staging area. The site is dominated by non-native grasses. Six high priority invasive plants are documented near the helipad site. Those species are listed below. The site is not suitable habitat for any rare species.

Species of Concern

Threatened and Endangered Species

No federally listed threatened, endangered (T&E) or proposed plant species are known to occur on the MBS. No formal consultation is required. T&E species will not be addressed any further in this document.

Rare Plants

Suitable habitat for thirteen R6 Sensitive plants exists within the project area. A complete list of these species can be found in the project record.

Invasive Plants

Invasive species have been documented within the Green Mountain Horse Pasture. Six high priority invasive species are documented at the Pasture: *Potentilla recta (*Sulphur cinquefoil), *Cytisus scoparius* (Scotch broom), *Arctinum minus* (lesser burdock), *Tanacetum vulgare* (common tansy), *Cirsium vulgare* (bull thistle), and *C. arvense* (Canada thistle). It is unknown if invasive species are present at the proposed monitoring sites.

3.3.2 Environmental Consequences

Alternative A - No Action

The No Action Alternative proposes no change from the existing condition. The proposed new monitoring sites would not be installed.

No impacts are expected to rare plants from the No Action Alternative. Current conditions and trends associated with rare plants in the project area would continue, as outlined in the Affected Environment section above.

Alternative B: Proposed Action – Rare Plants

Rare plants can be negatively affected by the installation and maintenance of a seismic monitoring and GPS station. Effects can be caused by, but not limited to, direct injury, solar exposure alteration, hydrologic pattern alteration, soil alteration, microclimate alteration, and/or invasive species introduction. The degree of effects is relative to where an individual occurs in relation to disturbing activities. In addition, the extent and duration of the effects may influence the magnitude of direct and indirect effects.

Direct and Indirect Effects

It is assumed that the Pine species atop Miner's Ridge at GP02 is *Pinus albicaulis*. *Pinus albicaulis* seedlings and saplings may be trampled during implementation of this project, resulting in damage or loss of some individuals. Therefore, the species may be impacted at this site. The impact from this project would be short in duration.

Although suitable habitat is present for *Botrychium ascendens*, *Campanula lasiocarpa*, *Carex scirpoidea* ssp. *scirpoidea*, *Erigeron salishii*, *Eurybia merita*, *Gentiana glauca*, *Kalmia procumbens*, *Luzula arcuata* ssp. *unalaschcensis*, *Oxytropis monticola*, *Packera porteri*, *Pellaea breweri*, and *Poa nervosa*, it is unknown whether or not the habitat is occupied. If they are present, one or more individuals or species may be impacted by the proposed project activities.

Alternative B: Proposed Action – Invasive Species

Invasive plants can be affected by the installation of monitoring stations, gear and equipment transport, and associated or related activities. Potential effects can include introduction, establishment, and spread of invasive plants within the project area, mainly from contaminated equipment, supplies, and clothing.

Direct and Indirect Effects

High priority invasive plants are documented within the Horse Pasture. The following measures are recommended to reduce, if not eliminate, the likelihood of spreading these invasive plants to the proposed monitoring sites:

- Treat known infestations within and around the helipad site and staging area before implementation.
- It is recommended that the site be mown prior to use, and during the duration of use, to keep staged equipment and supplies free of weedy propagules, such as seed, that can be transported to another site.

Effect Determinations

Species discussed in this report are known to occur in specific microhabitats within rocky, heaths, and or meadow subalpine and alpine environments near and above treeline throughout their known range. Similar suitable subalpine/alpine habitats, and habitat connectivity, protected in the Glacier Peak Wilderness are expected to provide for long term persistence of these rare species on the Mt. Baker-Snoqualmie National Forest. Table 5 lists the biological determination for the known or suspected R6 Sensitive species in the project area. In summary, the effects determination for the thirteen species is *May Impact Individuals or Habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species throughout their range on the Mt. Baker-Snoqualmie National Forest.*

Table 5 - Biological Determinations for R6 Sensitive Species

Scientific Name	GP01	GP02	GP03	GP04	GP05
Botrychium ascendens	X[4]	MI[5]	X	X	X
Campanula lasiocarpa	MI	MI	MI	MI	MI
Carex scirpoidea ssp. scirpoidea	X	X	X	X	MI
Erigeron salishii	MI	X	X	X	MI

[4] X stands for no suitable habitat or known species at the proposed project site.
[5] MI stands for May Impact Individuals or Habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the populations or species throughout their range on the Mt. Baker-Snoqualmie National Forest.

Scientific Name	GP01	GP02	GP03	GP04	GP05
Eurybia merita	MI	X	X	X	MI
Gentiana glauca	X	X	X	MI	X
Kalmia procumbens	MI	MI	MI	MI	X
Luzula arcuata ssp. unalaschcensis	X	MI	MI	MI	MI
Oxytropis monticola	MI	X	X	X	MI
Packera porteri	X	X	X	MI	MI
Pellaea breweri	MI	X	X	X	MI
Pinus albicaulis	X	MI	X	X	X
Poa nervosa	X	MI	MI	MI	MI

Cumulative Effects

Cumulative effects are the accumulation of direct and indirect effects, due to the repetition and interaction over time, by other actions in the past, present, and foreseeable future, in addition to the proposed action. For this analysis, a cumulative effect is the result of the accumulation of impacts that may affect a rare plant or cause the introduction or spread of an invasive plant within the project area. The Sauk Subbasin serves as the cumulative effects analysis area.

Cumulative effects to *Pinus albicaulis* are expected to occur because the proposed project overlaps in space with the Miners Ridge Lookout, and overlaps in time with general use and maintenance of the Lookout. The Lookout has been in place since ~1930s. The view shed around the Lookout is maintained, therefore trees are cut. The site is a very popular hiking destination. The unmanaged recreation use at the site has likely caused the bare soil and trampling of vegetation observed in photos. However, implementation of this project, combined with past and future maintenance use of the site, would add very little impacts when compared to on-going and future recreation use of the site. There is other suitable habitat for *Pinus albicaulis* within the Sauk Subbasin.

For *Botrychium ascendens*, *Campanula lasiocarpa*, *Carex scirpoidea* ssp. *scirpoidea*, *Erigeron salishii*, *Eurybia merita*, *Gentiana glauca*, *Kalmia procumbens*, *Luzula arcuata* ssp. *unalaschcensis*, *Oxytropis monticola*, *Packera porteri*, *Pellaea breweri*, and *Poa nervosa*, no cumulative effects are expected because the project sites are so small compared to the amount of suitable habitat within the Sauk Subbasin.

No cumulative effects to invasive plants are expected due to required mitigation measures that would greatly reduce, if not eliminate, the likelihood of introduction and spread of the species in the project area.

Forest Plan Consistency

All Alternatives would meet the Forest Plan standards and guidelines for rare and invasive plants, and would therefore be consistent with the Forest Plan (USDA, 1990), as amended (USDA FS & USDI BLM, 1994). The Botany Specialist Report, located in the Project Record, lists applicable Forest Plan Standards and Guidelines relevant to the USGS Seismic Monitoring Project. Implementation of the required mitigation measures would be consistent with all botany-related Forest Plan standards and guidelines.

Specialist Report

This EA hereby incorporates by reference the Botany Specialist Report (40 CFR 1502.21). The Botany Specialist Report is located in the Project Record and contains the detailed data, tables, maps, Affected Environment, analysis, references, reports, and technical documentation that the project ID Team's Botanist relied upon to reach the conclusions in this section of the EA.

3.4 Recreation and Wilderness

3.4.1 Affected Environment

Glacier Peak Wilderness

The Glacier Peak Wilderness is the central component of what has become a 2.7 million acre National Park and National Forest wilderness complex that straddles the rugged North Cascade Range from Canada to Snoqualmie Pass. With elevations ranging from 1,100 to 10,541 feet, the wilderness is even more expansive geologically and ecologically than its acreage would indicate. The eastern boundary of the wilderness touches the tinder-dry forests on the shoreline of Lake Chelan. The western side is a soggy and tangled mosaic of old growth fir, hemlock and cedar laced by avalanche chutes of vine maple and slide alder. Higher elevations host broad meadows and cirques filled with about 200 lakes. In the fall, the high country on the Cascade Crest and east is dotted with groves and patches of golden subalpine Larch. Huckleberry leaves turn crimson and light up the meadow country throughout the wilderness.

A 450 mile trail system, some of it stock accessible, provides access to the wilderness. The Pacific Crest National Scenic Trail (PCT) wanders around the west and north sides of Glacier Peak, diving into deep valleys and climbing alpine passes.

Recreation

There is a range of developed and dispersed recreation opportunities available along the Suiattle Road that includes developed camping, backpacking, picnicking, fishing, day hiking, hunting, gathering, and rafting. Visitor registration data collected in 2015 and 2016 shows that roughly 2,000 visitors registered at the Suiattle River trail, which is a 10.8 mile long trail that connects to the PCT, and provides access to Miner's Ridge Lookout, Image Lake, and other popular destinations and climbing routes around the Glacier Peak Wilderness area.

The location of Miners Ridge Lookout, has long been recognized as having a commanding view of the Suiattle River drainage and surrounding ridgelines and peaks. The tower is occasionally staffed by volunteers and during periods of high forest fire danger in the region. The current tower is on the National Historic Lookout Register. This lookout site is one of the most remote in Washington in terms of minimum hiking distance required to reach the location.

The western half of Miners Ridge is quite popular for hikers, photographers, and other outdoor enthusiasts. Miners Ridge Lookout is well known in the region, but so are the areas approximately one mile east along the ridgetop. Image Lake is a tiny picturesque lake that has long been a favorite destination for hikers, and backcountry campsites are located nearby and only a few minutes further east of the lake.

The North Fork Sauk, Lost Creek Ridge and Bald Eagle Trails are other primary access trails to the Pacific Crest Trail and the Glacier Peak Wilderness. The North Fork Sauk Trail is the most heavily used with nearly 2,000 visitors registered in the 2016 recreation season. This high use

trail accessed by Forest Road #49 connects to the Pacific Crest Trail about 8.5 miles from the trailhead. It is popular among novice and experienced backpackers, day use hikers and mountain climbers alike. While Lost Creek Ridge and Bald Eagle are relatively lower use than North Fork Sauk, with 658 and 448 visitors recorded during 2016 respectively, these trails provide access to some of the most remote locations for backpacking, and day hiking around Glacier Peak wilderness.

3.4.2 Environmental Consequences

The analysis areas for direct and indirect effects are confined to the Glacier Peak Wilderness Area and the trails and roads utilized to access this area, specifically Miner's Ridge Trail, sections of the Pacific Crest Trail, Suiattle River Trail, North Fork Sauk Trail, Lost Creek Ridge, Bald Eagle Trail, and the Green Mountain Horse Pasture. Field reconnaissance, staff experience, visitor data, and maps were used to analyze effects from the proposed action.

Recreation Areas

Alternative A - No Action

In this alternative, the new seismic monitors would not be installed and the systems upgrade on an existing site would not be implemented. There would be no effects on recreation resources under this alternative. This alternative would result in a diminished ability for scientists at the USGS to detect and interpret signals recorded by the instruments in order to provide early and accurate warnings of impending seismic or volcanic activity to the U.S. Forest Service and other governmental officials so that they can effectively administer, manage, and make appropriate land use decisions to protect the lives and safety of visitors to the recreation areas surrounding Glacier Peak.

Alternative B - Proposed Action

Direct and Indirect Effects

Due to the remote locations of the areas proposed for installing monitoring stations, these actions are expected to have minimal direct or indirect effects to recreation resources and the visiting public. Most of the monitoring stations are being installed more than 1 mile from high use recreation areas and hiking trails and are likely to be invisible from a major road or hiking trail, expect for the station installed at Miner's Ridge Lookout. Minor disruptions along trails or roads during the transportation and installation of the structures may occur but are unlikely to substantially affect access to roads and hiking trails in the Glacier Peak area. The proposed action would have no effect on the Recreation Opportunity Spectrum since all of the currently available recreation opportunities in the area would continue to exist without any changes.

The proposed action would not substantially affect visitor use levels or public safety. During installation of seismic stations, Green Mountain Horse Pasture would be used as a staging area for approximately 6 days. The horse pasture is an administrative site and not open to public use.

Wilderness Areas

Alternative A - No Action

In this alternative, the new seismic monitors would not be installed and maintenance on an existing monitor would not be implemented. There would be no effects on wilderness resources under this alternative. This alternative would result in a diminished ability for scientists at the

USGS to detect and interpret signals recorded by the instruments in order to provide early and accurate warnings of impending seismic or volcanic activity to the U.S. Forest Service and other governmental officials so that they can effectively administer, manage, and make appropriate land use decisions to protect the lives and safety of visitors to the wilderness and areas adjacent to the wilderness.

Alternative B - Proposed Action

Direct and Indirect Effects

The following sections discuss the effects of the proposed action within the framework of the five qualities of wilderness character and other factors.

Untrammeled - *An untrammeled area is an area where the earth and its community of life are untrammeled by man and generally appears to have been affected primarily by the forces of nature. Wilderness is essentially unhindered and free from modern human control or manipulation.*

- Proposed Action - Installation of Seismic Monitoring Stations Using Motorized Equipment to Transport Equipment and Personnel

  The project will have a total footprint of about 150 square feet in 5 locations and will not result in any control over wilderness processes.

Undeveloped - *Undeveloped areas are Federal lands without permanent improvement or human habitation and where man himself is a visitor who does not remain. Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.*

- Proposed Action - Installation of Seismic Monitoring Stations Using Motorized Equipment to Transport Equipment and Personnel

  The project would result in two new permanent electronic installations that would be a sign of human occupation of the wilderness. These installations would be located in a manner that would make it unlikely wilderness visitors would find them. Three installations would coexist with existing wilderness administrative sites including, a Forest Service Fire Lookout Tower, a Forest Service Radio Repeater electronics shed, and an older seismic station operated by the Pacific Northwest Seismic Network (University of Washington). The existing seismic station would be upgraded to modern standards. The helicopter use would not result in any temporary or permanent improvements or evidence of human occupation of the wilderness. No landing zones would be developed, or trees cleared for helicopter operations.

  An electric drill would be used at GP01 to make a 2 ½" diameter x 36" deep hole to support the mast for the GPS antenna. There is no soil at this site, as at the others, to dig a hole for the mast.

Natural - *Wilderness is managed to preserve natural ecological systems which are substantially free from the effects of modern civilization.*

- Proposed Action - Installation of Seismic Monitoring Stations Using Motorized Equipment to Transport Equipment and Personnel

  For this project two new stations would be added in areas not currently occupied by a Forest administrative site. The total footprint of these two sites would be on the order of 150 square feet. The small amount of area disturbed by these sites would not alter the natural character of wilderness.

Solitude - *Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.*

- Proposed Action - Installation of Seismic Monitoring Stations Using Motorized Equipment to Transport Equipment and Personnel

  It is possible that some visitors may have their experience of solitude degraded by the presence of a helicopter delivering equipment and personnel to the seismic sites. However, all of these sites are located in remote parts of the wilderness. Visitors along the North Fork Sauk, Suiattle and Pacific Crest Trail may see, or hear, the helicopter passing overhead on its way to its destination. Visitors on Miners Ridge may hear or see the helicopter delivering equipment to the Miners Ridge site. Climbers on Glacier Peak rarely utilize routes that involve Streamline Ridge or the Scimitar Glacier due to their remoteness and would not likely be impacted. Climbers ascending Glacier Peak usually cross into the upper White Chuck Basin about ½ mile southeast of GP01 and would likely have their solitude interrupted by the presence of the helicopter as it delivers supplies to that station. Flight paths to this site would be routed to avoid the upper White Chuck basin to the maximum extent possible. The most heavily visited site is the Miners Ridge Lookout. While people are not camping at the Lookout, it is a popular destination for hikers in the area. They may also have their experience of solitude impacted by the helicopter.

  The three person crews would all camp within a few hundred feet of the installations. It is unlikely that other visitors would come into contact with the crews.

  Drilling of the hole for the GPS antenna mast would take under 1 hour at GP01.

Other Feature of Value

The Wilderness Act also identifies other features of value (i.e. "ecological, geological, or other features of scientific, educational, scenic or historical value.") No other features of value were identified that would be affected by any alternative.

Other Factors

- Maintaining Traditional Skills –

  None of the electronic equipment to be installed is traditional in the common sense. Utilizing backpacking, cross country navigation, and wilderness camping skills would be maintained under the proposed action. The proposed action would utilize the helicopter to transport crews to the project sites.

- Safety of Visitors and Workers –

The proposed action involves travelling on system trails and also involves cross country travel in some very rugged country. Steep slopes, cliffs, heavy vegetation, steep snow fields, glacial stream fords, and frequent bad weather, requires a very fit and technically skilled team to access the project area. While carrying heavy loads for many person days, the risk of injury due to falls is substantial in this environment.

Safety is a primary concern during work around helicopters. Crews are recommended to only utilize helicopters certified for use by the Forest Service. Helicopter transport in mountainous terrain poses numerous challenges due to vicissitudes in weather conditions, unpredictable winds, and lift conditions in varying temperatures. Disparate temperature conditions and elevations could result in modified load limits.

All equipment would be loaded into slings at Green Mountain Pasture and would be ferried to the project sites. Due to the nature of this project there are no approved landing zones at the project sites.

Cumulative Effects

There are no known cumulative effects anticipated for this project which would affect recreation resources. Two projects that may overlap in space and time with the USGS project are the Grizzly Bear reintroduction and Mountain Goat relocation projects. The use of helicopters to facilitate the proposed action would be short term and occur mid-week, to the extent possible, when public use levels are low. There will be no lasting impact to wilderness character as a result of the use of helicopters or motorized/mechanized equipment to install the seismic monitoring stations.

Forest Plan Consistency

Both Alternatives would be consistent with the Forest Plan Standard and Guidelines (USDA, 1990), as amended (USDA FS & USDI BLM, 1994) for recreation. The Recreation and Wilderness Specialist Report, located in the Project Record, lists applicable Forest Plan Standards and Guidelines relevant to the USGS Seismic Monitoring Project.

Specialist Report

This EA hereby incorporates by reference the Recreation and Wilderness Specialist Report (40 CFR 1502.21). The Specialist Report is located in the Project Record and contains the detailed data, tables, maps, Affected Environment, analysis, references, reports, and technical documentation that the project ID Team's Recreation and Wilderness Specialist relied upon to reach the conclusions in this section of the EA.

3.5 Visual Quality

3.5.1 Affected Environment

The affected areas would be a visual radius ranging from 10 meters to 100 meters around the following locations on the Darrington Ranger District, Mt. Baker-Snoqualmie National Forest (MBS or Forest):

1. GP01 would be a new seismic station located in Section 29, T30N, R14E, and Willamette Meridian (W.M.).

2. GP02 would be a new seismic station which would be co-located with the Miner's Ridge Lookout in Section 7, T31N, R15E, and W.M.
3. GP03 would be a new seismic station which would be co-located at the Lost Creek Ridge radio repeater station in Section 5, T30N, R12E, and W.M.
4. GP04 would be a new seismic station located in Section 11, T30N, R14E, and W.M.
5. #GPW is an existing seismic station located in Section 8, T30N, R14E, and W.M.

Visual Quality Analysis, 1990 Forest Plan, and Agency Handbooks

Scenery on the Forest is managed through the application of the Visual Management System (VMS) (USDA Forest Service, 1974) and the 1990 Forest Plan. Based on inventory ratings and management direction, lands within the Forest are assigned one of five Visual Quality Objectives (VQOs), listed as follows from most to least protective: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. The basic definitions of these objectives are as follows:

1. *Preservation* - Allows ecological changes only.
2. *Retention* - Human activities are not evident to the casual Forest visitor.
3. *Partial Retention* - Human activity may be evident, but must remain subordinate to the characteristic landscape.
4. *Modification* - Human activity may dominate the characteristic landscape, but must, at the same time follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middle ground.
5. *Maximum Modification* - Human activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

The management allocation for the areas in which the 5 location fall within the Glacier Peak Wilderness area and are designated 10D or "Dedicated Trailless" and 10B or "Wilderness-Trailed" as delineated in the 1990 Forest Plan. The Plan states that all wilderness areas are to be managed at the "preservation" VQO.

3.5.2 Environmental Consequences

Alternative A - No Action

No direct or indirect effects are anticipated from the No Action Alternative beyond those that occur due to other management activities that are not part of or connected to the Proposed Action. Current conditions and trends associated with visuals in the project area would continue, as outlined in the Affected Environment section above.

Alternative B – Proposed Action

Direct and Indirect Effects

Rugged topography and lush forests surround project sites, restricting views of them from road and trail viewsheds. There are few locations along established trails, undefined climbing routes, and Glacier Peak, where the five seismic stations could be visible without the aid of magnification (i.e. spotting scopes or binoculars). The vast majority of these areas are in places where large amounts of the recreating public rarely travel. The visual disturbance that would be

created by the installation of seismic monitoring stations is so low and insignificant in contrast to the existing and vast visual context and backdrop of the wilderness in which they would be located. In addition, the numbers of visitors that may be off an establish trail or route in order to be close enough to see these monitoring stations are not in high volumes or frequency. The monitoring data obtained from this proposed action would also play a role in providing safety information to the recreationist that desire to hike and climb Glacier Peak, creating a more informed recreationist. It is also recognized that there has been volcanic activity in recent time – geological speaking, this landscape is prone to modification and changes on a dramatic scale, resulting in possible future visual impacts in regards to the landscapes' current visual condition and quality. The VQO in this area is Preservation, however it is determined that given the above considerations that the Glacier Peak wilderness area, as a whole, in character, quality, and spirit would not be visually impacted by this proposed action and that the intent of the Forest Plant and associated VQO of Preservation would still be intact and supported. That said the management practices and suggested mitigation measures should be considered and implemented where possible.

Generally, any adjacent viewsheds or established trails, in which visitors may be recreating, are at such a great distance or views are obstructed by vegetation and topography, such that the recreating public would not be affected by this proposed action.

Cumulative Effects

It is determined that there are no direct, indirect, or cumulative visual effects from this proposed action.

Specialist Report

This EA hereby incorporates by reference the Visual Quality Specialist Report (40 CFR 1502.21). The Visual Quality Specialist Report is located in the Project Record and contains the detailed data, tables, maps, Affected Environment, analysis, references, reports, and technical documentation that the project ID Team's Visual Quality Specialist relied upon to reach the conclusions in this section of the EA.

3.6 Wildlife

3.6.1 Affected Environment

The analysis area for effects includes both the area of potential direct effects to wildlife and indirect effects (potential noise effects disturbance from motorized and large equipment and habitat changes). The wildlife project area of potential effects was identified as Glacier Peak Wilderness and 1 mile around the helicopter staging areas in the Suiattle River drainage. Analysis for the grizzly bear included a review of the Bear Management Units (BMUs) surrounding Glacier Peak. Spotted owl and marbled murrelet analysis included assessment of the designated critical habitat areas within the Suiattle River where the helicopter staging area is located.

Stand year-of-origin maps and aerial photographs were initially examined to identify areas within the project area or adjacent to the project area for potential suitable habitat for species of concern. District files and databases were reviewed for historic locations of wildlife species including threatened and endangered species. On-the-ground assessment of the project area was based on past experiences within the Glacier Peak Wilderness. The proposed project area is

familiar to the wildlife biologist from previous travels in the Suiattle River drainage so that the major habitats and topographic features are known.

Scope of Wildlife Species Analysis

The wildlife analysis focused on potential effects to Federal listed Threatened and Endangered Species and associated designated critical habitat (as administered under the Endangered Species Act), MBSNF Sensitive Species, Forest Management Indicator Species (MIS) Northwest Forest Plan Survey and Manage Species, (www.fs.fed.us/r6/sfpnw/issssp/). Consequences were also assessed for migratory birds and species of concern (riparian species such as amphibians, mollusks and bats) from the Forest Plan, as amended (USDA Forest Service 1994). (http://web.or.blm.gov/records/ib/2004/ib-or-2004–106.htm).

Table 6 on page 49 provides the list of threatened, endangered, and sensitive species; management indicator species, species of concern, survey and manage species; and migratory birds considered in this analysis. The table also indicates each species' status on the Mt. Baker-Snoqualmie National Forest, or if its habitats are present in the Project area. The last column in the table provides a summary determination of effects of the proposed action.

A discussion of the all species listed in table 6 and their preferred habitat is provided in the Affected Environment section in the wildlife specialist's report in the Project Record.

3.6.2 Environmental Consequences

The analysis area for proposed project is the Glacier Peak Wilderness area of the Suiattle, White Chuck and N.F. Sauk River drainages, and a 1 mile area around the helicopter staging area of the Green Mountain horse pasture.

The project was reviewed in GIS due to the low amount of perceived impact resulting from the extremely small footprint and lack of habitat manipulation. No surveys were completed because of the lack of habitat loss. Disturbance was the key factor with additional analysis for those species within the range of the helicopter transport of materials to one or more sites. Disturbance was analyzed by evaluating the amount of disturbance area within a home range of a species. For example: various distance radii out from the helicopter landing site (depending on helicopter size) were created in GIS and used to assess the amount of area with risk of disruption to owls and murrelets.

The potential effects to federally threatened, endangered, and sensitive species; management indicator species; survey and manage species; migratory landbirds; and snags and downed wood habitat are evaluated. Based on the proposed action, there is very little potential impact on wildlife species or their habitat. The project footprint is small and does not require the removal of any large vegetation so there are no habitat-changing activities. Potential impacts are assessed for disturbance to wildlife from transporting materials to and installing the monitoring equipment at the sites, as well as the long-term maintenance of the sites.

Alternative A - No Action

The No Action Alternative would have no direct effects to the wildlife species or habitat for the multiple species under review in the sections below (table 6). Current trends in wildlife populations would continue for the foreseeable future with little change in the current habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks. The

background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak. Habitat and trends are described in the "Affected Environment" section of the Wildlife Specialist Report, in the Project Record.

Alternative B - Proposed Action

Direct and Indirect Effects

Habitat: The proposed Alternative would have no change in the habitat for the multiple species assessed in the project area (see table 6). No habitat is proposed to be removed or substantially altered, and wildlife would habituate to the limited footprint of the seismic monitoring equipment.

Disturbance: Noise and human disturbance is of concern for wildlife when the extent of the disturbance may interfere with the species' ability to survive or breed. Noise disturbances to wildlife from proposed helicopter operations were assessed at the seismic monitoring sites for the duration of the installation, and also for maintenance. This involved a review of the helicopter use areas of the Green Mountain Horse Pasture, travel routes, and installation sites. Human disturbance was also assessed for wildlife in the locations of the monitoring sites and travel routes to and from the seismic monitoring stations. Frequency of disturbance as well as scope of the disturbance was part of the review. Human disturbance was assessed for activities by crews that would spend 2-3 days at each seismic monitoring site for the installation of the equipment. Disturbance from helicopter flights were projected for every 3 to 4 years for equipment maintenance or replacement.

A discussion of the all species listed in table 6 and their preferred habitat is provided in the Affected Environment section of the wildlife specialist's report in the Project Record. The following species were considered but found to not occur within the project area or to not have habitat within the proposed action areas: Harlequin duck, Johnson's hairstreak butterfly, Shiny tightcoil snail, broad whorl tigthcoil snail, Puget Oregonian snail and common loon. Therefore, the proposed project would have "no impact" upon them.

The remaining species have potential habitat at least in portions of the project area and species have been assessed for potential impacts to habitat or disturbance with a focus on the following species: northern spotted owl, marbled murrelet, grizzly bear, gray wolf, wolverine, Cascade red fox and mountain goat.

Threatened and Endangered Species

Section 7 consultations on the Glacier Peak Seismic Monitoring project was initiated with scoping of the proposed project in 2015 and further discussion in 2016 and 2017 on the use of the Forest Programmatic Biological Assessment with the Level 1 team comprised of U.S. Forest Service and U.S. Fish and Wildlife Service staff. Informal discussion from field meetings and

Level 1 meetings resulted in the following effects determinations. The proposed action would result in *"may affect, not likely to adversely affect*" for the northern spotted owl, gray wolf and grizzly bear and a *"may affect, likely to adversely affect*" for marbled murrelet due to noise disturbance during the breeding season in adjacent, unsurveyed mature forests. Both alternatives would have a *"no effect"* for spotted owl and marbled murrelet critical habitat.

Table 6 - Wildlife Resources Analyzed

Species or Habitat	Forest Status	Preferred Habitats	Habitat Present in Analysis Area (Yes or No)	Effects Determination for the proposed Action
Northern Spotted Owl[2] *(Strix occidentalis caurina)*	Federally Threatened/MIS	Mature, old-growth forests (nesting, roosting, foraging); second-growth used for dispersal	Yes- adjacent to helicopter staging areas	Helicopter noise adjacent Habitat – NLAA after 7/16 <1 ac.- 65 yd. radius
Critical Habitat[2]**, Northern Spotted Owl**	Federally Designated	Mature, old growth forests	Yes	No change
Marbled Murrelet [2](*Brachyramphus marmoratus m.)*	Federally Threatened	Mature, old-growth forests (nesting, roosting)	Yes- adjacent to helicopter staging areas	Helicopter noise NLAA <1ac.- 110 yd. radius
Critical Habitat[2]**, Marbled Murrelet**	Federally Designated	Mature, old growth forests	Yes	No change
Grizzly Bear[2] (*Ursus arctos horribilis)*	Federally Threatened/MIS	Security habitat > 300 m from road	Yes	No change core hab. NLAA ,Disturbance
Gray Wolf[2] (*Canis lupus)*	Federally Endangered/MIS	Security habitat > 300 m from road, ungulate prey base	Yes	Disturbance, no change prey , NLAA
American Peregrine [1] Falcon (*Falco peregrinus anatum*)	R6-Sensitive/ MIS	Cliff habitat for nesting	Yes	No impact, no change in cliffs for nesting
Common Loon (*Gavia immer)*	R6-Sensitive	Lakes for nesting and brooding young	No	No impact
Bald Eagle[1] *(Haliaeetus leucocephalus)*	R6-Sensitive/ MIS	Roost, nest habitat & forage areas near lakes, reservoirs, rivers with readily available food source (fish & carrion)	Yes	No impact, helicopter use outside of winter forage period
Harlequin Duck (*Histronicus histronicus)*	R6-Sensitive	Swift moving streams (rivers and creeks) for nesting and brooding young	No	No habitat impact, helicopter use outside of habitat

California wolverine (*Gulo gulo luscus*)	R6-Sensitive	Large expanse of minimally disturbed habitats	Yes	Displacement, No change in habitat
Species or Habitat	**Forest Status**	**Preferred Habitats**	**Habitat Present in Analysis Area (Yes or No)**	**Effects Determination for the proposed Action**
Mountain Goat (*Oreamnos americanus)*	R6-Sensitive/MIS	Mountain goat habitat (cliffs, rock outcrops, forest cover)	Yes	Displacement, No change in habitat
Townsend's big-eared bat (*Corynorhinus townsendii*)	R6-Sensitive	Abandoned mine shafts and other human-made structures for roosting and hibernacula; Foraging in forest edges	Yes – forage habitat	No impact: limited use areas, helicopter use outside of bat forage hrs.
Northern Goshawk *(Accipiter gentilis)*	R6-Sensitive/WA	Associated with mature to old forest stands, but found in 2nd growth stands	Yes	Disturbance, No change in habitat
Western bumble bee (*Bombus occidentalis)*	R6 -Sensitive	Early seral vegetation - pollinator	Suspected	No change in habitat
Little brown myotis *(Myotis lucifugus)*	R6-Sensitive/WA	Caves, mine tunnels, hollow trees, bridges or buildings as roost sites. Forest foraging	Yes	No impact: limited use areas, helicopter use outside of bat forage hrs.
Cascade red fox *(Vulpes vulpes cascadensis)*	R6-Sensitive/WA	Mixture of forest and open country	Yes	Disturbance, No change in habitat
Johnson's hairstreak butterfly (*Callophrys johnsoni)*	R6-Sensitive	Old-growth coniferous forests; use of mistletoe (genus *Arceuthobium*)	No	No impact, no change in habitat
Melissa artic butterfly *(Oeneis melissa)*	R6 -Sensitive	Sedges in talus slopes, rocky summits and saddles and frost-heaved clear-cuts	Unknown, 2012 Okanogan	No impact

Valley Silverspot butterfly *(Speyeria zerene bremnerii)*	R6 -Sensitive	Open prairies and grasslands	Unknown	No Impact
Shiny Tightcoil *(Pristiloma wascoense)*	R6 -Sensitive Survey & Manage	Information on habitat, ecology, population numbers & range lacking.	No	No impact
Species or Habitat	**Forest Status**	**Preferred Habitats**	**Habitat Present in Analysis Area (Yes or No)**	**Effects Determination for the proposed Action**
Broadwhorl tightcoil snail (*Pristiloma johnsoni*)	Sensitive/survey and manage	Leaf litter deciduous-coniferous forests below 1300 m elevation	no historic detections	No impact
American Marten (*Martes americana)*	MIS	Old-Growth and Mature Forest	Yes	No impact to forest habitat
Primary Cavity Excavators	MIS	Snags and Downed Logs	Yes	NE, no change in habitat components
Pileated Woodpecker *(Dryocopus pileatus)*	MIS	Range of Old-Growth and Mature Forest	Yes	NE, no change in habitat components
Puget Oregonian *(Cryptomastix devia)*	Survey & Manage	Associated with hardwood logs, leaf litter, moist rocks and talus.	No	No impact
Migratory Birds/ golden eagle	Species of Concern	Vegetation of all successional stages including meadows, shrub, snags and cliffs.	Yes	Disturbance, no change in habitat components
Deer and Elk	Species of Concern	Vegetation providing both cover and forage (early seral vegetation)	Yes	No impact, no change in habitat components

[a] Impacts are attributed to disturbance only during the nesting season. Habitat would not be removed.
**Impacts due to disturbance would not trend a species towards Federal listing under the Endangered Species Act.
[1]Species are delisted and addressed as sensitive species
[2]Species/CHU addressed in the biological assessment
[3]Species addressed in the biological assessment
[4]Surveys not required due to no impacts to suitable old growth habitat

The project consistency form for the Biological Assessment (2017) prepared for consultation with USFWS and the Biological Opinion can be found in the Project Record and Forest files at the Forest Supervisor's Office.

Northern Spotted Owl

Alternative A - No Action

Direct and Indirect Effects

The No Action Alternative would have no direct effects to the northern spotted owl or to its habitat. The No Action Alternative would continue to provide both suitable spotted owl nesting and dispersal habitat within the drainages surrounding Glacier Peak Wilderness. There would be no change in the background noise levels from low level overflights by jet military craft flying in the drainages surrounding Glacier Peak. Noise from mechanical and manual methods to control invasive plants, including equipment used to mow and spray roadside would continue.

Alternative B - Proposed Action

Direct and Indirect Effects

Habitat: Alternative B would have no changes to suitable spotted owl habitat from the installation of the seismic monitoring equipment in the alpine areas.

Disturbance: Elevated noise disturbance was assessed for within 0.25 mile and within a 110 yard radius circumference of the staging area for the helicopter operations. Much of the area surrounding the horse pasture has had previous management and is in second growth, so there is a very limited amount of older forest (< 1 acre) within noise disturbance radius for a lighter sized helicopter.

In order to minimize impacts to potential fledgling of any spotted owls, helicopter operations would be scheduled after July 16th. This would eliminate noise disturbance during the early breeding season for owls within the 110 yard radius of a medium helicopter (Hugh 500) operating out of the Green Mountain Horse Pasture. The amount of mature and old forest that would be impacted by rotor wash and elevated noise is limited to 110 yards radius from operations (USDI FWS, 2013) and would account for less than 1 acre of mature forest The acres affected by noise would represent <0.01 percent of the old forest in the Suiattle River drainage.

Helicopter noise disturbance to spotted owls is a low probability because the operating season for the helicopter activities would be outside the early breeding season when the young would not be mobile. There would be no change in the background noise levels from low level overflights by jet military craft flying in the drainages surrounding Glacier Peak. Noise from mechanical and manual methods to control invasive plants, including equipment used to mow and spray roadside would continue. Potential noise disturbance was consulted on with FWS as a *"may affect, not likely to adversely affect"* determination for spotted owl due to the limited scale and scope of the potential disturbance, and the timing of helicopter operations after July 16th.

Northern Spotted Owl Critical Habitat

Alternative A - No Action and Alternative B – Proposed Action

There would be no change in critical habitat with the No Action Alternative and with Alternative 2's proposed installation of the monitoring equipment in the alpine areas of Glacier Peak Wilderness which would be outside of spotted owl critical habitat. The use of the Green

Mountain Horse Pasture would not change the character of that potion of spotted owl critical habitat therefore the Proposed Action would have "no effect" on spotted owl critical habitat.

Marbled Murrelet and Critical Habitat

Alternative A - No Action

Implementing the No Action Alternative would have no direct or indirect effects on marbled murrelets and nesting habitat. The current background noise levels in the Suiattle, White Chuck or NF Sauk River drainages would continue with elevated noise disturbance from the military training jets over suitable nesting habitat within the project area.

Alternative B - Proposed Action

Habitat: There would be no change in suitable murrelet nesting habitat with the installation of seismic monitoring equipment around Glacier Peak. The installations are outside of suitable murrelet nesting habitat.

Disturbance: The proposed action does have potential for additional noise disturbance within unsurveyed mature forest habitat from helicopter operations at the Green Mountain Horse Pasture. Elevated noise disturbance was assessed for within 0.25 mile and within a 110 yard radius circumference of the staging areas for the helicopters which had a very limited amount of mature forest of < 1 acre within that zone. Potential noise disturbance was consulted on with FWS as a "*may affect, not likely to adversely affect*" determination for marbled murrelet due to the limited scale and scope of the potential disturbance.

If the proposed motorized mechanical treatment would last longer than one day in a single location, the mandatory mitigation measures for marbled murrelets require that these methods, or others that generate sufficient noise (greater than 92 dB), to be conducted farther away than 110 yards, or outside the breeding season. This mitigation would minimize effects to marbled murrelets because it minimizes or eliminates the source of disturbance near nests or suitable habitat. Operating restrictions would include use of helicopters within the daily work window of from 2 hours after sunrise to 2 hours before sunset from April 1 to September 23rd. The acres affected by noise represent <0.01 percent of the old forest in the project area and do not include the old growth forest use areas with historic occupied murrelet detections.

Noise from mechanical and manual methods to control invasive plants, including equipment used to mow and spray roadside and pasture vegetation would be conducted within the daily operating guidelines. The current background noise levels in the Suiattle, White Chuck or NF Sauk River drainages would continue with elevated noise disturbance from the military training jets over suitable nesting habitat within the project area. Therefore the proposed action would not measurably add to the current background noise levels within the project area, and "*may affect, but is not likely to adversely affect*" marbled murrelets.

Cumulative Effects for Proposed Action

The cumulative effects for murrelets is as described in the northern spotted owl section above. There would be no direct impacts to habitat, with any incidental noise disturbance from road and trail maintenance overshadowed by on-going military jet overflights.

Marbled Murrelet Critical Habitat

Alternative A - No Action and Alternative B – Proposed Action

There would be no change in critical habitat with the No Action Alternative and with Alternative B's proposed installation of the monitoring equipment in the alpine areas of Glacier Peak Wilderness which would be outside of marbled murrelet critical habitat. The use of the Green Mountain Horse Pasture would not change the character of that potion of marbled murrelet critical habitat therefore the Proposed Action would have "*no effect*" on marbled murrelet critical habitat.

Grizzly Bear

Alternative A - No Action

Habitat: There would be no change to the physical habitat from the No Action Alternative.

Disturbance: There would be no change in grizzly bear core habitat (> 0.3 mi from open road/high use trail) with the No Action Alternative. Human presence would continue with backpackers, hikers and climbers' use of the area with use focused primarily on trails and peaks. This alternative would result in the continuation of the current conditions and trends of habitat availability and visitor use to the peaks and Glacier Peak Wilderness. Green Mountain BMU #12 with the staging area and three of the monitoring stations encompasses approximately 99,450 acres, entirely within federally managed land. Core habitat would continue to be 92 percent of this BMU in the early season and 83 percent in the late season. A status of 70 percent core habitat for interior BMUs is considered desirable by the Interagency Grizzly Bear Committee [IGBC 2001]). BMU #9 contains 118,038 acres of both the Suiattle and White Chuck River drainages. Core area is also high with 92 percent core in early season and 75 percent in late season (USDA FS 1998). The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

Alternative B - Proposed Action

Habitat: Alternative B would result in no change in the physical condition of habitat associated with grizzly bear in the North Cascades with a continuation of current conditions and habitat trends. The structure housing the monitoring equipment would have a minimal footprint (approximately 25 sq. feet/site) and would be an inanimate object which are not suspected to be an impact to grizzly bears. Wildlife typically have not avoided inanimate objects as is evident in photos of bears and a variety of other wildlife species captured on remote game camera, and in use of overpass and underpass road crossings.

Disturbance: There would be no change in the core habitat, with continued human presence from backpackers, hikers and climbers' use of the area, focused primarily on trails and peaks. Impacts from helicopter flights and crews as part of the equipment placement would increase overnight visitor use in the seismic monitoring sites with the potential for short term displacement of wildlife use of the area during the summer season. Given the amount of core habitat in the Bear Management Units (BMUs) surrounding Glacier Peak, the impact of overnight visitors for 2-3 night in the area would not result in a change in the percent of core area available for grizzly bear. The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

Cumulative Effects

For this project, the area of grizzly bear cumulative effects analysis is the project area and federal lands encompassed by BMUs #12 and #9. Appendix B was reviewed for projects within the vicinity that had the potential for cumulative effects. The time span of effects would include past, present, and reasonably foreseeable project that have resulted or could result in a net change in core habitat within BMU #12 or #9.

Past and Current Actions

Habitat: Watershed restoration and road decommissioning has increased grizzly bear core habitat. Disturbance: Road and trail maintenance in the analysis area would have no cumulative effects on grizzly bears or core habitat due to the limited areas impacted at any one time by maintenance activities within a large home range.

Future Actions

Habitat: There would be no increase in road, or campsites so there would be no net loss of grizzly core acres. Disturbance from trail and road maintenance is projected to remain similar to current levels.

Gray Wolf

Alternative A - No Action

Habitat: As described in the effects to grizzly bear above, there would be no change in physical habitat with the No Action Alternative. There would be no change in denning and prey base for the gray wolf outside of the natural events such as wind storms, floods, fire, and insect and disease outbreaks.

Disturbance: Human presence would continue with backpackers, hikers and climbers' use of the project area with use focused on trails. Background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak.

Alternative B - Proposed Action

Habitat: There would be no change in physical habitat that would impact denning or foraging capabilities. Wolf density is related to available food resources (Mech 1970, Fuller and Keith 1980, Fuller 1989) particularly ungulates such as elk and deer and other alternative prey. Much of the Suiattle River watershed and Glacier Peak Wilderness has coniferous forests with closed canopies and little development of forage for ungulates which would provide prey for wolves. The structure housing the monitoring equipment would be located outside of denning, and typical foraging habitat. Wolves could disperse through the areas where the seismic equipment is housed. These structure would have a minimal footprint (approximately 25 sq. feet/site) and would be an inanimate object which wildlife typically have not avoided as is evident in photos of wolves and a variety of wildlife species captured on remote game cameras, and in wolf proximity to infrastructure and other human structures in other parts of Washington. Due to no change in the prey base for this species, and no change in denning or dispersal habitat, Alternative 2 would have no changes in habitat for this species.

Disturbance: Relative isolation from human activity is considered a beneficial characteristic of quality wolf habitat. Alternative B would have no change in the core habitat (see grizzly bear assessment above), with continued human presence from backpackers, hikers and climbers' use of the area, focused primarily on trails and peaks. Impacts from helicopter flights and crews as

part of the equipment placement would increase overnight visitor use in the seismic monitoring sites with the potential for short term displacement. Helicopter flights and human activity associated with installation and maintenance of the monitoring stations could result in disturbance or displacement of wolves which would be temporary to the 2-3 days of operations at a site over the course of 1 season. The limited time scale and scope of this disturbance would not change the amount of core area ((> 0.3 mi from open road/high use trail). Alternative B would not result in a substantial change in disturbance levels or secure habitat.

Cumulative Effects

For this project, the grizzly bear cumulative effects analysis was used for the gray wolf in assessing security areas from disturbance. Disturbance from other projects would not be measurable and would not result in a change in effects determination for the gray wolf.

Regional Forester's Sensitive Species

Terrestrial wildlife species on the Regional Forester's Sensitive Species list for the Mt. Baker-Snoqualmie National Forest, and not currently Federally listed or proposed under the Endangered Species Act, are: Larch Mountain salamander, VanDyke's salamander, boardwhorl tightcoil, shiny tightcoil, common loon, peregrine falcon, mountain goat, wolverine, northern goshawk, harlequin duck, Cascade red fox, Johnson's Hairstreak butterfly, Western bumblebee, Silverspot butterfly, Melissa artic butterfly, Townsend's big-eared bat, little brown bat, and bald eagle.

Habitat for loon (large lakes), Larch Mountain and VanDyke's salamanders (range south of Highway 2) is not present within or near the proposed project area. No impacts to these species or their habitat would result from either Alternative. These species will not be discussed further in this document. Sensitive species with habitat within the project area were reviewed for impacts from the proposed action, or location where activities would occur.

American Peregrine Falcon

Alternative A - No Action

The No Action Alternative would have no direct or indirect effects to the peregrines or its habitat.

Habitat: Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks. The Green Mountain Horse Pasture would continue to be maintained as a helicopter staging area.

Disturbance: The background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak, and on-going visitor use of backpackers, climbers, and hikers, with use focused along the trail system and climbing routes.

Alternative B – Proposed Action

Habitat: Cliffs and rock outcrops in relatively open areas are generally selected for nest locations. Glacier Peak has rock outcrops, and cliff faces that may provide suitable nesting habitat for peregrines, but none of the sites selected for equipment installation include those features or are at an elevation typically used by peregrines for nesting (Pagel 1992, USDI Fish and Wildlife Service, 2003).

Due to the lack of a suitable nesting habitat in the project area where activities are proposed, this project would not impact peregrine or its habitat. The project would not contribute to a negative

trend in the viability of this sensitive species on the Forest and would not contribute towards federal listing.

Bald Eagle

Alternative A - No Action

The No Action Alternative would have no direct or indirect effects to the bald eagle or its habitat.

Habitat: Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks. The Green Mountain Horse Pasture would continue to be maintained as a helicopter staging area.

Disturbance: The background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak, and on-going visitor use of backpackers, climbers, and hikers, with use focused along the trail system and climbing routes.

Alternative B – Proposed Action

Bald eagle use of the project area is within the winter season (November through March) when bald eagles in the Pacific Northwest use a large foraging area that includes most rivers in the Puget Sound region. None of the sites selected for equipment installation include features used as nesting or foraging by bald eagles. All activities associated with helicopter use with the proposed project would be in the summer months outside of the bald eagle use period, therefore there would be no impacts to bald eagles. Therefore the proposed action would not contribute to a negative trend in the viability of this sensitive species on the Forest and would not contribute towards federal listing.

Harlequin Duck

Alternative A - No Action

Habitat: The harlequin duck is a small diving sea duck that nests on the Mt. Baker-Snoqualmie National Forest. Nesting habitat is generally found within inland forests where clear, low gradient and swift moving streams are present. (Lewis and Krage 1999). The No Action Alternative would have no direct or indirect effects on harlequin duck habitat. Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms and floods.

Disturbance: The background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak, and on-going visitor use of harlequin duck habitat focused along the recreational use of the river systems and camping sites.

Alternative B – Proposed Action

Habitat: The installation of the seismic equipment is outside of suitable harlequin duck habitat, and all activities associated with helicopter use would also be outside of the Riparian Reserve of potential nest rivers.

Disturbance: There would be no change in recreational use of the river system from this project. Therefore, there would be no impacts to harlequin ducks or their habitat from this project and the proposed action would not contribute to a negative trend in the viability of this sensitive species on the Forest and would not contribute towards federal listing.

Johnson's Hairstreak Butterfly

Alternative A - No Action

The Johnson's hairstreak butterfly (*Loranthomitoura johnsonii)* larvae are reported to feed exclusively on hemlock dwarf mistletoe shoots. The No Action Alternative would have no direct or indirect effects on the Johnson's hairstreak butterfly or its habitat.

Habitat: Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks. The Green Mountain Horse Pasture would continue to be maintained as a helicopter staging area.

Alternative B – Proposed Action

Habitat: The seismic equipment installation is in alpine areas, outside of suitable habitat of the western hemlock zone and the helicopter staging will be in an open field. Therefore there would be no impacts to western hemlock or potential dwarf mistletoe shoots from the proposed project, and the proposed action would not contribute to a negative trend in the viability of this sensitive species on the Forest and would not contribute towards federal listing.

Valley Silverspot Butterfly

Alternative A - No Action

Habitat: The Valley silverspot butterfly is historically known from southwestern British Columbia south to west-central Oregon. In Washington, the butterfly occurs on the San Juan Islands, along the Washington Coast Range, and in the Puget Trough (Pyle 2002). The No Action Alternative would have no direct or indirect effects on the Valley silverspot butterfly or its habitat. Habitat: Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks. The Green Mountain Horse Pasture would continue to be maintained as a helicopter staging area.

Alternative B – Proposed Action

Habitat: The seismic equipment installation is in alpine areas, outside of the butterfly's suitable habitat of meadows of Puget Sound. The use of Green Mountain Horse Pasture as a staging area, but not change the maintenance of this field as early seral vegetation.

Disturbance: The use of Green Mountain Horse Pasture as helicopter staging could have short term disturbance to pollinators of up to 15 days in 1 season. Impacts to the butterfly could include a temporary displacement of use in the area during helicopter operations, typically less than 1 week/site during 1 season. This potential disturbance is expected to be negligible, and amount of undisturbed meadow habitat within the Glacier Peak Wilderness and the rest of the project area would not change. Therefore the proposed action may impact individuals, but would not contribute to a negative trend in the viability of this sensitive species on the Forest, nor would it contribute towards federal listing.

Melissa Artic Butterfly

Alternative A - No Action

The Melissa Artic butterfly is not well-known, reported to be found in habitat of tundra, talus slopes, rocky summits and saddles and frost-heaved clear-cuts. Eggs are laid on sedges or in litter around them, with caterpillars feeding at night and pupate under mosses and rocks. Little is known of the butterfly's foods.

Habitat: The No Action Alternative would have no change in Melissa Artic Butterfly habitat. Current trends would continue for the foreseeable future with little change in habitat outside of natural events such as wind, storms, floods, fire, and insect and disease outbreaks. The Green Mountain Horse Pasture would continue to be maintained as a helicopter staging area.

Disturbance: There would be no change in disturbance. Recreation users would continue to use the trails and climbing routes with some potential for trampling of suitable alpine habitat. The recreation use areas constitute a minor portion of the alpine areas, and recreational disturbance would not measurably impact the butterfly's habitat.

Alternative B – Proposed Action

Habitat: The seismic equipment installation is in alpine areas, but installation sites are targeted for rocky areas and not the sedge habitat associated with the butterfly's larva stage.

Disturbance: Impacts to the butterfly could include trampling of suitable alpine habitat at the installation sites or from crew camping near installation sites. This potential disturbance is expected to be negligible, and the amount of secure habitat within the Glacier Peak Wilderness and the rest of the project area would not change. Therefore the proposed action may impact individuals, but would not contribute to a negative trend in the viability of this sensitive species on the Forest, nor would it contribute towards federal listing.

Townsend's Big-eared Bat and Little Brown Bat

Alternative A - No Action

These species typically use caves, abandoned mines, bridges or buildings for roosting habitat, particularly for maternity colonies and winter hibernacula (Fellers et al 2002). Forest edges, early seral habitats, roads, and other similar open habitat conditions may provide forage habitat (Johnson and Cassidy 1997) (Fellers et al 2002). The No Action Alternative would have no direct or indirect effects to these species. There are no known sites on the Darrington District with incidents of bats impacted by white-nose syndrome.

Habitat: Current trends in wildlife populations would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks.

Disturbance: The background noise levels would include the overflights of military training jets within the drainages surrounding Glacier Peak, and on-going visitor use of backpackers, climbers, and hikers, with use focused along the trail system and climbing routes.

Alternative B – Proposed Action

Habitat: With the exception of bridges, caves, abandoned mines, and buildings are generally absent from near the Project area. Roosting habitat would be provided by Forest structures.

Disturbance: While there are no known roost sites that would be impacted by the proposed action, the helicopter operations would be within a potential foraging areas for bats. All activities associated with helicopter use with this project would be confined to daytime hours, therefore no impacts to Townsend's big-eared bats or little brown bats foraging would result from this project. There are no known aspects of the project that would contribute to the spread of white-nose syndrome. Therefore, the proposed action would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Northern Goshawk

Alternative A - No Action

The northern goshawk can range from sea level to alpine settings, but typically nest in mature and old-growth forests with more than 60% closed canopy. The No Action Alternative would have no direct or indirect effects to the northern goshawk.

Habitat: Current trends in goshawk populations and habitat would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks.

Disturbance: There would be no change in the background noise levels in the project area which include the overflights of military training jets within the drainages surrounding Glacier Peak, and on-going visitor use of backpackers, climbers, and hikers, with use focused along the trail system and climbing routes.

Alternative B – Proposed Action

Habitat: The proposed equipment installation sites are not within suitable goshawk nesting areas, and there would be no change in the forest habitat surrounding the helicopter staging area. Therefore, there would be no change in habitat components with Alternative B for the northern goshawk.

Disturbances: Alternative B would have helicopter and motorized operations adjacent to unsurveyed suitable goshawk roosting, nesting and foraging habitat. While disturbances to northern goshawks are most often associated with habitat removal, equipment operations are of concern within a nesting area for potential nest abandonment. Goshawks are known to fiercely defend their nest, and if raptor nest sites are found within the project area during implementation, activities will stop and a Forest Service Wildlife Biologist will be consulted. At the biologist's discretion protective buffers and/or seasonal operation restrictions (March 15th to August 3rd) may be assigned to newly located active nest sites.

There would be no disturbance from alpine helicopter flights or from crew activities at the installation sites for the seismic since those sites would be outside of suitable nesting habitat. The potential for disturbance at the helicopter staging area is minimal due to the mitigation measure above for raptor nest sites. Any disturbance of short duration would be expected to have little impact on nesting birds based on experiences from viewing and trapping birds during the nesting period noted as not causing nest abandonment (Austin 1993, McGrath et. al 2003, Reynolds et. al, 2006).

Therefore the proposed action would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute towards federal listing.

Western Bumblebee

Alternative A - No Action

The Western bumblebee is reported to inhabit a wide variety of natural, agricultural, urban, and rural habitats, although species occurrence tends to peak in flower-rich meadows of forests and subalpine zones (Goulson 2003, 2003b). The No Action Alternative would have no direct or indirect effects to the bumblebees or their habitat.

Habitat: Current trends in bee populations would continue for the foreseeable future with little change in habitat outside of natural events such as wind storms, floods, fire, and insect and disease outbreaks.

Disturbance: The Green Mountain Horse Pasture would continue to be maintained with mowing or vegetation removal as a helicopter staging area.

Alternative B – Proposed Action

Habitat: Alternative 2 would not change bumblebee habitat at the Green Mountain Horse pasture or at the alpine area for seismic equipment installation. The rocky alpine sites are not suspected to provide western bumblebee foraging habitat.

Disturbance: The use of Green Mountain Horse Pasture as helicopter staging could have short term disturbance to pollinators of up to 15 days in 1 season. Impacts to the bumblebee could include a temporary displacement of use in the area during helicopter operations, typically less than 1 week/site during 1 season. This potential disturbance is expected to be negligible due to the limited amount area with helicopter disturbance (< 1 acre), and due to the amount of undisturbed meadow habitat within the Glacier Peak Wilderness and the rest of the project area that without disturbance. The proposed activities may impact individuals, but are would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Cascade Red Fox

Alternative A - No Action

There are no known sightings of Cascade red fox in the project area. Although this species is often associated with upper elevation areas they could disperse or move though lower elevations.

Habitat: The No Action Alternative would make no change in the current stand conditions or road density.

Disturbance: There would be no change in the background disturbances levels.

Alternative B - Proposed Action

Habitat: Under this alternative, there would be no impacts to habitat for the fox.

Disturbance: There would be a short-term (1 seasons for equipment installation) increase in human access with project activities within the project area. While Cascade fox in Mt. Rainier National Park have become habituated to visitors (Akins, 2012, 2016; Sacks et. al 2010), the prosed action would limit the time crews are in the alpine setting within potential fox habitat, therefor limiting time for habitation. All crews would practice food management to limit attracting wildlife. Impacts to the fox could include a temporary displacement of use in the area during the work, typically less than 1 week/site during 1 season. This potential disturbance is expected to be negligible, and amount of secure habitat within the Glacier Peak Wilderness and the rest of the project area would not change.

The proposed activities may impact individuals, but are would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Wolverine

Alternative A - No Action

Wolverines are far-ranging species, dispersing or moving though lower elevations as well as occupying a variety of alpine and subalpine habitats (Aubrey et al. 2007). Detections of wolverine in Glacier Peak Wilderness in 2012 (District files) support the assumption that wolverine are present in the project area.

Habitat: The No Action Alternative would make no change in habitat conditions that would impact wolverine use of the project area.

Disturbance: There would be no change in the background disturbances levels. Recreation users would continue to use the trails and climbing routes with some potential for disturbance of wolverine in the project area. The recreation use areas constitute a minor portion of the alpine areas, and recreational disturbance would not measurably impact wolverine use of habitat.

Alternative B - Proposed Action

Habitat: Alternative B would result in no change in the physical condition of habitat associated with wolverine in the North Cascades; there would be a continuation of current conditions and habitat trends. The structure housing the monitoring equipment would have a minimal footprint (approximately 25 sq. feet/site) and would be an inanimate object which are not suspected to be an impact to wolverine. Wildlife typically have not avoided inanimate objects as is evident in photos of wolverines and a variety of other wildlife species captured on remote game cameras.

Disturbance: There would be no change in the core habitat (areas assessed in the grizzly bear section as area >0.3 miles from open roads or high use trails). Alternative would not change the current human presence from backpackers, hikers and climbers' use of the area, focused primarily on trails and peaks. Impacts from helicopter flights and crews as part of the equipment placement would increase overnight visitor use in the seismic monitoring sites with the potential for short term displacement of wildlife use of the area during one summer season. Given the amount of core habitat in the Bear Management Units (BMUs) surrounding Glacier Peak, the impact of overnight visitors for 2-3 night in the area would not result in a change in the percent of core area available for wolverine. The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

The proposed activities may impact individuals, but are would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Mountain Goats

Alternative A - No Action

Native populations of mountain goats are found in Glacier Peak Wilderness, within the project area.

Habitat: The No Action Alternative would make no change in current goat habitat.

Disturbance: There would be no change in the background disturbances levels. Recreation users would continue to use the trails and climbing routes with some potential for disturbance of mountain goats in the project area. The recreation use areas constitute a minor portion of the alpine areas, and recreational disturbance would not measurably impact mountain goat habitat.

Alternative B - Proposed Action

Habitat: Alternative B would result in no change in the physical condition of habitat associated with mountain goats in the North Cascades; there would be a continuation of current conditions and habitat trends. The structure housing the monitoring equipment would have a minimal footprint (approximately 25 sq. feet/site) and would be an inanimate object which are not suspected to be an impact to mountain goats. Wildlife typically have not avoided inanimate objects as is evident in photos of a variety of wildlife species captured on remote game cameras.

Disturbance: Alternative B would not change the current human presence from backpackers, hikers and climbers' use of the area, focused primarily on trails and peaks. Impacts from helicopter flights and crews as part of the equipment placement would increase overnight visitor use in the seismic monitoring sites with the potential for short term displacement of mountain goats near the equipment sites during one summer season. Due to the short duration of the work and camps (2-3 nights/site over 1 season), there would be little time for mountain goat to habituate to people.

Given the amount of habitat surrounding Glacier Peak without human contact (see grizzly bear assessment), the impact of overnight visitors for 2-3 night in the area would not result in a change in the percent of secure area available for mountain goats The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

The proposed activities may impact individuals, but are would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Cumulative Effects for sensitive species

The cumulative effects for sensitive species described above, were reviewed with the list of past, present and future projects in Appendix B. The analysis areas used the Suiattle River Bear Management Units that were described in the grizzly bear sections above. The proposed action either did not overlap in time and space with other projects, or the impacts from the actions were not measurable in terms of changes in habitat or disturbance to the above species. Therefore, the proposed action has the potential to generate disturbance that may impact individuals, but when combined with other projects, would not contribute to a negative trend in the viability of these sensitive species on the Forest and would not contribute to a trend towards federal listing.

Forest Management Indicator Species (MIS)

The MBS Forest "indicator" species are listed in table 6. Effects to MIS species of spotted owl, gray wolf, grizzly bear, peregrine, and mountain goat are described in above sections on threatened and endangered species and sensitive species. Due to the lack of impacts to MIS species of pine marten, pileated woodpeckers, and primary cavity excavators or their habitat (as described in Section 7 Affected Environment), these species are not be further discussed in this analysis. Viability assessments for MIS are included in the 2011 Forest MIS Assessment (USDA Forest Service 2011) and this report is incorporated by reference (40 CFR 1502.21).

American Marten

Alternative A - No Action

American marten are associated with Pacific-silver fir zone old growth forest and with both natal dens and maternal dens found in stands with large amounts of down wood (Raphael and Jones,

1997). The No Action Alternative would make no change in habitat conditions that would impact American Marten use of the project area.

Alternative B - Proposed Action

Habitat: Alternative B would result in no change in the physical condition of habitat associated with marten in the project area. The alpine equipment installation is outside of suitable marten habitat, and there would be no change in the early seral vegetation from use of the horse pasture as a helicopter staging area.

Disturbance: Impacts from helicopter use of the staging area is less than 1 acre of mature habitat 110 yards from the center of the helicopter landing area. The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

Due to the proposed project not being within suitable habitat or projected to have impacts on old-growth forest and down wood, there would be no impacts to marten from the proposed project. Therefore the proposed action would not contribute to a negative trend in the viability of this management indicator species on the Forest.

Pileated Woodpecker and Primary Cavity Excavators

Alternative A - No Action

Habitat: Pileated woodpeckers and primary cavity excavators are associated with snags of various sizes being retained on the landscape The No Action Alternative would make no change in habitat conditions that would impact pileated woodpecker use of the project area.

Alternative B - Proposed Action

Habitat: Alternative B would result in no change in snags or the physical condition of habitat associated with primary cavity excavators in the North Cascades.

Disturbance: Impacts from helicopter use of the staging area is less than 1 acre of mature habitat 110 yards from the center of the helicopter landing area. The background noise levels from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue.

Due to the lack of the project's impacts on standing or down wood, there is no change expected in these habitat components from the proposed action, and therefore the proposed action would not contribute to a negative trend in the viability of this management indicator species on the Forest.

Migratory and other Landbirds

Species and habitat associations for the Forest are listed in table 6 of this document. Adult bird foraging and flying activity has been observed within the project area so nesting by migratory bird species is expected within the project area, but there are no formal survey records to indicate distribution and abundance. While migrating raptors are often found using ridge systems, there is no migratory flyway known by raptors along either of the peaks. Raptors have been identified foraging in the meadows below the peaks, and golden eagles are known to forage in the alpine areas.

Alternative A - No Action

Habitat: The No Action Alternative would make no change in habitat conditions that would impact migratory and other landbirds use of the project area.

Disturbance: The background noise levels and disturbance from overflights of military training jets within the drainages surrounding Glacier Peak are expected to continue as well as on-going visitor use of backpackers, climbers, and hikers, with use focused along the trail system and climbing routes

Alternative B - Proposed Action

Habitat: There is no change in the habitat components from proposed action for avian species. The migratory land bird species associated with forest and upland landscape have the mobility to avoid any activities associated with the proposed action, so there would be no effects from the action alternative

Disturbance: Disturbance impacts from helicopter use of the staging area is less than 1 acre of mature habitat 110 yards from the center of the helicopter landing area. Therefore the proposed action would have a limited area of potential impacts to suitable nesting habitat for many songbirds and raptors at the Green Mountain horse pasture. Noise from mechanical and manual methods to control invasive plants, including equipment used to mow and spray roadside and pasture vegetation would be conducted within the daily operating guidelines.

The helicopter flights to the seismic monitoring stations would be over Forest lands considered suitable foraging areas for raptors and songbirds, but the height of the helicopter flights, except for landing and take-off would limit the helicopter disturbance to raptors and songbirds. Limited exposure of raptors to helicopter flights is not thought to be a negative impact based on well-documented use of helicopters as a means of successfully surveying golden eagle nests without known adverse effects (Grubb et. al. 2010 and United States Fish and Wildlife Service, 2010). Songbirds and raptors would continue to be subject to the background noise levels and disturbance from overflights of military training jets within the drainages surrounding Glacier Peak which are expected to continue. Therefore the proposed action would not measurably add to the current background noise levels and disturbance within the project area.

Due to the lack of the project's impacts on habitat or and the lack of substantial change in noise disturbance levels, there is no change expected in the habitat components from the proposed action, and therefore the proposed action would not contribute to a negative trend in the viability of these species on the Forest.

Survey and Manage

Species and habitat associations for the Forest are listed in table 6 of this document. There are no known locations of survey and manage mollusks on the Mt. Baker-Snoqualmie National Forest. The proposed project would not impact suitable habitat for survey and manage mollusk species. Due to no change in habitat components for target mollusk species, there would be no impacts to these species from the no action or proposed action alternatives.

Forest Plan Consistency

All Alternatives would meet the Forest Plan standards and guidelines for wildlife, and would therefore be consistent with the Forest Plan (USDA, 1990), as amended (USDA FS & USDI BLM, 1994). The Wildlife Specialist Report, located in the Project Record, lists applicable Forest Plan Standards and Guidelines relevant to the USGS Seismic Monitoring Project.

Specialist Report

This EA hereby incorporates by reference the Wildlife Specialist Report (40 CFR 1502.21). The Wildlife Specialist Report is located in the Project Record and contains the detailed data, tables,

maps, Affected Environment, analysis, references, reports, and technical documentation that the project ID Team's Wildlife Biologist relied upon to reach the conclusions in this section of the EA.

3.7 Other Environmental Components

3.7.1 Environmental Justice

On February 11, 1994, President Clinton issued the Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898). This order directs agencies to identify and address disproportionately high and adverse human health or environmental effects of projects on certain populations. In accordance with this order, the proposed activities have been reviewed to determine if they would result in disproportionately high and adverse human and environmental effects on minorities and low-income populations.

This project is located within Glacier Peak Wilderness. As such, the project is not located close to any communities and is difficult to access. The project would be implemented by USGS and does not involve the sale of any commercial products. As such, no specific concerns regarding minorities or low-income populations or communities were identified during the planning or public involvement process.

This project would positively impact the communities of Darrington, Arlington, and the Everett metropolitan area, including minorities, low-income populations and women. As a potentially active volcano, Glacier Peak poses significant volcano, landslide, flood, channel migration, and earthquake hazards to nearby communities and community assets. The proposed monitoring stations in the Glacier Peak Wilderness would assess volcanic activity to inform the early warning system regarding volcanic hazards and public safety.

3.7.2 Prime Forestland, Prime Farmland, Rangeland, etc.

Prime forestland, as defined by Natural Resources Conservation Service[6], may be found on the MBS National Forest. However, it is estimated that none of the alternatives, including No Action, would have any measurable impact on such lands.

There is no prime farmland or rangeland within the project area, so there would be no effects from the alternatives.

Climate, energy, fire, insects, disease, and other smaller environmental components, etc. were considered at the outset of the environmental analysis, but they are not analyzed or described in further detail here because they are associated with limited or no environmental impacts from the Proposed Action.

[6] Land capable of growing wood at the rate of 85 cubic feet per acre per year at culmination of mean annual increment.

3.7.3 Floodplains and Wetlands

There are no impacts to wetlands or floodplains because none are located at the proposed monitoring sites. Section 3.1, hydrology, soil, and fisheries, provides more details on the limited aquatic resources found in the project area.

3.7.4 Potential Conflicts with Plans and Policies of Other Jurisdictions

Private individuals, groups, and governmental agencies, including Tribal representatives, have been contacted about the USGS Seismic Monitoring project. Several private individuals and Tribal representatives have been in contact with Forest personnel in regard to this project (refer to Chapter 1, section 1.9, Public Involvement; and Chapter 4 – Consultation and Coordination, 4.2 Tribes). There are no known conflicts between alternatives described in this document and the plans and policies of any other jurisdictions.

3.7.5 Wild and Scenic Rivers

The designated Skagit Wild and Scenic River is located near some portions of the project area. The Skagit system includes portions of the Skagit, Cascade, Sauk and Suiattle Rivers and covers approximately 150 river miles. The Green Mountain Pasture is an administrative site located within the "Scenic" segment of the system. There would be no effects to the pasture beyond its short term use as a staging area for helicopter operations.

Chapter 4 - Consultation and Coordination

On May 14, 2015, the Forest Service sent letters to initiate government-to-government consultation with local Tribes for this proposal. A complete list of all the Tribes consulted for this project can be found below in section 4.2.

On May 15, 2015, the Forest Service sent scoping notices of this proposal to interested citizens, groups, organizations, and agencies. The Forest Service received 12 written comments from interested citizens and organizations. The scoping and comment letters received are available in the Project Record. A complete list of those individuals and interested groups who received information regarding this proposal can be found in the Project Record.

On July 11, 2018, the Forest Service sent consultation notices to local Tribes and requested comments on the draft environmental assessment. No comments were received from any of the local Tribes.

On July 16, 2018, the Forest Service sent request for comment notices of this proposal to interested citizens, groups, industry, and agencies. The Forest Service received 14 written comments from interested citizens and organizations, 11 supportive and 3 opposed to the project.

4.1 Federal, State, and Local Agencies

Endangered Species Consultation

Section 7 consultations on the Glacier Peak Seismic Monitoring project was initiated with scoping of the proposed project in 2015 and further discussion in 2016 and 2017 on the use of the Forest Programmatic Biological Assessment with the Level 1 team comprised of U.S. Forest Service and U.S. Fish and Wildlife Service staff. Informal discussion from field meetings and Level 1 meetings resulted in the following effects determinations. The proposed action would result in *"may affect, not likely to adversely affect*" for the northern spotted owl, gray wolf and grizzly bear and a *"may affect, likely to adversely affect*" for marbled murrelet due to noise disturbance during the breeding season in adjacent, unsurveyed mature forests. Both alternatives would have a *"no effect"* for spotted owl and marbled murrelet critical habitat.

The project consistency form for the Biological Assessment (2017) prepared for consultation with USFWS and the Biological Opinion can be found in the Project Record and Forest files at the Forest Supervisor's Office.

4.2 Tribes

The following Tribes were contacted during the May 14, 2015 consultation efforts:

1. Lummi Indian Business Council
2. Samish Tribe
3. Sauk-Suiattle Tribal Council
4. Stillaguamish Board of Directors
5. Swinomish Tribal Community
6. Tulalip Board of Directors
7. Upper Skagit Tribal Council

The 30-day public scoping and Tribal consultation period began on May 15, 2015. The District Ranger sent Government-to-Government consultation letters to the Lummi Indian Business Council, Samish Tribe, Sauk-Suiattle Tribal Council, Stillaguamish Board of Directors,

Swinomish Tribal Community, Tulalip Board of Directors, and Upper Skagit Tribal Council. One written response was received from the Stillaguamish Board of Directors regarding the proposed project activities. In addition, the project was presented to the Sauk-Suiattle Tribal Council at a tribal government consultation and coordination meeting on November 7, 2014.

Chapter 5 - List of Preparers

The following personnel were involved in the preparation of this EA:

Name	Title	Responsibility
Todd Griffin	Forest Geologist	Team Lead
Paul Alford	Forest Archeologist	Heritage Analysis
Jeremy Gilman	North Zone Fisheries Biologist	Fisheries Analysis
Christopher Stewart	Hydrologist	Watershed Analysis
David Keenum	GIS Data Services Specialist	GIS Analysis and Maps
Stella Torres	Recreation	Recreation & Wilderness
Rourke McDermott	Public Services Manager	Visual Analysis
Shauna Hee	North Zone Botanist	Botany Analysis
Phyllis Reed	North Zone Wildlife Biologist	Wildlife Analysis
Sarah Lange	Recreation Planner	MRA Review
Andrew Montgomery	Zone Environmental Coordinator	NEPA Review
Ben Pauk	USGS Geophysicist	Technical Review

Chapter 6 - References Cited

Akins, J. 2012. Conservation status of the Cascades Red Fox. Science Brief, Mount Rainier national Park. Available at: http://www.nps.gov/mora/naturescience/upload/CascadeFox_Akins2012-CCP-ScienceBrief.pdf

Akins, Jocelyn, 2016. Ecology and Conservation: The Cascade Red Fox. Mazamas blog of 3 08 2016 http://mazamas.blogspot.com/2016/03/by-jocelyn-akins-ph.html

Almack, J.A., W.L. Gaines, P.H. Morrison, J.R. Eby, R.H. Naney, G.F. Wooten, M.C. Snyder, S.H. Fitkin, and E.R. Garcia. 1994. North Cascades Grizzly Bear Ecosystem evaluation: final report. Interagency grizzly bear committee, Denver, Colorado.

Aubrey, K.B., K.S. McKelvey, and J.P. Copeland. 2007. Distribution and Broadside Habitat Relations of the Wolverine in the Contiguous United States. Journal of Wildlife Management vol 71, no. 7 : 2147 58.

Aubry, Keith B. 1983. The Cascade red fox: distribution, morphology, zoogeoraphy and ecology. University of Washington. https://digital.lib.washington.edu/researchworks/handle/1773/5517

Aubry, Keith B.; Halpern, Charles B.; Peterson. Charles E. 2009. Variable-retention harvest in the Pacific Northwest: A review of short-term findings from the DEMO study. Forest Ecology and Management 258 (2009) 398-408. http://www.sciencedirect.com/science/article/pii/S0378112709001753

Austin, K. 1993. Habitat use and home range size of breeding northern goshawks in the southern Cascades. Thesis, Oregon State University, Corvallis, Oregon.

Bart J. and E. Forsman. 1992. Dependence of northern spotted owls (Strix occidentalis caurina) on old-growth forests in the western USA. Biological Conservation 1992: 95 100.

Brown, E.R. 1985. tech. ed. Management of wildlife and fish habitats in forests of western Oregon and Washington. Portland, Oregon: USDA Forest Service, Pacific Northwest Region, 2 v. pp. 332.

Council on Environmental Council (CEQ), 40 CFR 1500-1508, Regulations for Implementing The Procedural Provisions of the National Environmental Policy Act (NEPA)

Courtney, S. P., J. A. Blakesley, R. E. Bigley, M. L. Cody, J. P. Dumbacher, R. C. Fleischer, A. B. Franklin, J. F. Franklin, R. J. Gutierrez, J. M. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status of the Northern Spotted Owl. Sustainable Ecosystems Institute, Portland, OR.

Fellers, G.M. and E.D. Pierson. 2002. Habitat use and foraging behavior of Townsend's big-eared bat (Corynorhinus townsendii) in coastal California. Journal of Mammalogy. 83(1): 167-177.

Franklin, J.F. and C.T. Dyrness. 1973. Natural Vegetation of Oregon and Washington. Oregon State University Press, Corvallis, Oregon.

Fuller, T. K., and L. B. Keith. 1980. Wolf population dynamics and prey relationships in northeastern Alberta. Journal of Wildlife Management 44:583-602.

Fuller, T. K. 1989. Population dynamics of wolves in north-central Minnesota. Wildlife Monograph 105. Wildlife Society, Washington, D.C.

GOERT, 2003. Gary Oak Ecosystems Recovery Team, Research Colloquium Proceedings 2003-2012, found on http://www.goert.ca/index.php

Goulson D (2003) Bumblebees: behaviour and ecology. Life Science. Oxford: Oxford University Press. 248 pp

Goulson, D. (2003b). Effects of Introduced Bees on Native Ecosystems. *Annual Review of Ecology, Evolution, and Systematics, 34*, 1-26. Retrieved from http://www.jstor.org/stable/30033767

Grubb, T.G., D.K. Delaney, W.W. Bowerman, M.R. Wierda. 2010 Golden Eagle Indifference to Heli-Skiing and Military Helicopters in Northern Utah. The Journal of Wildlife Management 4(6):1275- 1285

Guppy, C.S., and J.H. Shepard. 2001. Butterflies of British Columbia: Including Western Alberta, Southern Yukon, the Alaska Panhandle, Washington, Northern Oregon, Northern Idaho, and Northwestern Montana. UBC Press. Vancouver, B.C. 413 pp.

Hamer, T. E. 1998. Home range size of the northern barred owl and the northern spotted owl in western Washington. M.S. Thesis. Western Washington University, Bellingham, WA. 73 pp.

Hamer, T.E., E.D. Forsman, and E. M. Glenn. 2007. Home range attributes and habitat selection of barred owls and spotted owls in an area of sympatry. The Condor 109:750-768.

Hammond, Paul. 2006. Personal communication with Eric Scheuering, cited in USDA fact sheet prepared by Sarah Foltz, Xerces Society for Inveterate Conservation in 2009, updated with edits by Rob Huff, FS/BLM Conservation Planning Coordinator in June 2011, Portland OR

Holland, Andy. 1980. Switchbacks. The Mountaineers, Seattle Washington.

Hollenbeck, J.L. 1987. A Cultural Resource Overview: Prehistory, Ethnography and History: Mt. Baker- Snoqualmie National Forest. U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Region, Portland, Oregon.

Huff, Mark H.; Raphael, Martin G.; Miller, Sherri L.; Nelson, S. Kim; Baldwin, Jim, tech. coords. 2006. Northwest Forest Plan—The first 10 years (1994-2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 149 p. http://www.fs.fed.us/pnw/publications/pnw_gtr720/

Interagency Grizzly Bear Committee (IGBC). 2001. North Cascades ecosystem grizzly bear habitat assessment. Unpublished draft report. Darrington, WA: Darrington Ranger District files.

Johnson, R.E. and K.M. Cassidy. 1997. Terrestrial mammals of Washington State. Location data and predicted distributions. Volume 3 in Washington State Gap Analysis – Final Report. Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, 304 p.

Kato, A., Terakawa, T., Yamanaka, Y. et al. Earth Planet Sp (2015) 67: 111. https://doi.org/10.1186/s40623-015-0288-x.

Krebs, J., E. C. Lofroth, and I. Parfitt. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. Journal of Wildlife Management 71:2180–2192.

Larsen, J. et. al., 2009. Eruption of Alaska Volcano Breaks Historic Pattern. EOS, Volume 90, No. 20, pg. 173-180.

Lewis, J.C. and D. Kraege. 1999. Lewis' woodpecker. Pages 5-1 – 5-4 in E. Larsen, J. M. Azerrad, N. Nordstrom, editors. Management Recommendations for Washington's Priority Species, Volume IV: Birds. Washington Department of Fish and Wildlife, Olympia, Washington, USA.

Marshall, D.B. 1994. Status of the American marten in Oregon and Washington. Unpublished report, Audubon Society of Portland, Portland, OR. 38pp.

Mech, L. D. 1970. The wolf. Doubleday, New York. pp. 384.

Mellen-McLean, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2012. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.20. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon.

Nelson, S. K. and A. K. Wilson. 2002. Marbled Murrelet habitat characteristics on state lands in western Oregon. Final Rep., OR Coop. Fish and Wildlife Research Unit, Oregon State Univ., Dept. Fisheries and Wildlife, Corvallis. 151 pp.

Pagel, J.E. 1992. Protocol for observing known and potential peregrine falcon eyries in the Pacific Northwest. Pp. 83-96 In Proceedings: Symposium on peregrine falcons in the Pacific Northwest. J.E. Pagel, ed. Rogue River National Forest, Medford, OR 97501

Pyle, R.M. 2002. The Butterflies of Cascadia. A Field Guide to all the Species of Washington, Oregon, and Surrounding Territories. Seattle Audubon Society. 420 pp.

Raphael, M. and Jones, L. 1997. Characteristics of resting and denning sites of American marten in central Oregon and western Washington. In Martes. Taxonomy, ecology, techniques, and management. Eds Proxl, G., Bryant, H. and Woodward P. the Provincial Museum of Alberta, Canada, pp 146-165.

Richardson, S., D. Hays, R. Spencer, and J. Stofel. 2000. Washington state status report for the common loon. Washington Department of Fish and Wildlife, Olympia. 53 pp.

Sacks, B. N., M. J. Statham, J. D. Perrine, S. M. Wisely, and K. B. Aubry. 2010. North American montane red foxes: expansion, fragmentation, and the origin of the Sacramento Valley red fox. Conservation Genetics 11:1523–1539.

Thomas, J.W., E.D. Forsman; J.B. Lint; E.C. Meslow; B.R. Noon; and J. Verner. 1990. A conservation strategy for the northern spotted owl: a report of the Interagency Scientific committee to address the conservation of the northern spotted owl. Portland, Oregon. U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service. 427 pp.

USDA Forest Service. 1970. *Mt. Baker National Forest Soil Resource Inventory.* Pacific Northwest Region.

USDA Forest Service. 1974. National Forest Landscape Management, Volume 2. Chapter 1: The Visual Management System. Agriculture Handbook 462. Washington DC.

USDA Forest Service. 1990. Mt. Baker-Snoqualmie National Forest Land and Resource Management Plan. Seattle, WA.

USDA Forest Service. 1998. Grizzly Bear Core Area Analysis Summary. Unpublished Draft. USDA, Forest Service. Everett, WA: Mt. Baker-Snoqualmie National Forest.

USDA Forest Service. 2005. Record of Decision for the Pacific Northwest Region Invasive Plant Program: Preventing and Managing Invasive Plants. Portland, Oregon.

USDA Forest Service. 2004. Suiattle River watershed analysis, Darrington, WA: Darrington Ranger District, Mt. Baker-Snoqualmie National Forest.

USDA Forest Service. 2010. Soil Management Handbook. FSM 2550. Washington D.C., Washington Office.

USDA Forest Service. 2011. Forest-wide MIS Assessment Everett WA: Mt. Baker-Snoqualmie National Forest.

USDA Forest Service and USDI Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl and Standard and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Pacific Northwest Region. Portland, OR.

USDA Forest Service, USDI Bureau of Land Management. 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl. Portland, OR.

USDA Forest Service, USDI Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, Oregon.

USDA Forest Service, USDI Bureau of Land Management. 2004. Record of Decision to Clarify Provisions Relating to the Aquatic Conservation Strategy Amending Resource Management Plans. Portland, Oregon.

USDI Fish and Wildlife Service. 1997. Grizzly Bear recovery plan supplement: North Cascades ecosystem recovery plan. Missoula, MT: pp. 29.

USDI Fish and Wildlife Service. 2003. Monitoring Plan for the American Peregrine Falcon, A Species Recovered Under the Endangered Species Act. U.S. Fish and Wildlife Service,

Divisions of Endangered Species and Migratory Birds and State Programs, Pacific Region, Portland, OR. 53 pp.

USDI Fish and Wildlife Service. 2007. "Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife", Final Rule, 50 CFR Part 17. 72 Federal Register 130 (9 July, 2007), pp. 37346-37372.

USDI Fish and Wildlife Service. 2008a. Endangered and threatened wildlife and plants: revised designation of critical habitat for the northern spotted owl. Federal Register 73(157): 47326–47522.

USDI Fish and Wildlife Service. 2008b. Final Recovery Plan for the Northern Spotted Owl (Strix occidentalis caurina). Portland, Oregon

USDI Fish and Wildlife Service. 2011. Revised Recovery Plan for the Northern Spotted Owl (Strix occidentalis caurina). U.S. Fish and Wildlife Service, Portland, Oregon. xvi + 258 pp.

USDI Fish and Wildlife Service. 2012. Designation of Revised Critical Habitat for the Northern Spotted Owl. FR 77(23): 71876-72068

USDI United States Fish and Wildlife Service. 2010. Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle management and Permit Issuance.

USDI Fish and Wildlife Service. 2012. National Wetlands Inventory. Available online at: http://www.fws.gov/wetlands/index.html. Olympia, WA.

USDI Fish and Wildlife Service. 2013. Programmatic Biological Opinion for Aquatic Restoration Actives in the States of Oregon, Washington, and portions of California, Idaho and Nevada (ARBO II) FWS reference number 01EOFW00-2013-F-0090.

USDA Forest Service 2013, Biological Assessment for Fish Habitat Restoration Activities Affecting ESA-Listed Animal and Plant Species and their Designated or Proposed Critical Habitat and Designated Essential Fish Habitat Under MSA found in Oregon, Washington and parts of California, Idaho and Nevada".

USDI Geological Survey. 2005. An Assessment of Volcanic Threat and Monitoring Capabilities in the United States: Framework for a National Volcano Early Warning System (NVEWS). Open-File Report 2005-1164

Van Eaton, A., et al., 2016. Volcanic lightning and plume behavior reveal evolving hazards during the April 2015 eruption of Calbuco volcano, Chile. AGU Publications, Geophysical Research Letters 10.1002/2016GL068076.

Washington Department of Ecology (DOE). 2012. *Water Quality Standards for Surface Waters of the State of Washington.* Olympia, Washington: Washington State Department of Ecology: Publication No. 06-10-091, 2011.

Appendix A: Volcanic Monitoring Equipment Details

Table 7 - Volcanic Monitoring Equipment

Measure	 Fiberglass Enclosure		 Spider	
Designed use	Long-term monitoring		Rapid monitoring during an active volcano or landslide event	
Monitoring capability	Allows for monitoring and identification of both long- and short-term trends in seismic behavior and ground deformation of the volcano. Able to measure small- and large-scale ground deformation.		Allows for monitoring and identification of short-term trends in seismic behavior and ground deformation of the volcano. Only capable of large-scale ground deformation (sub-meter on a volcano or landslide). Not able to detect any long-term subtle ground deformation of the volcanic flanks.	
Data collection	All data is continuously transmitted in real time to USGS for data analysis and interpretation.		All data is continuously transmitted in real time to USGS for data analysis and interpretation when snow does not restrict performance.	
Weather resistance	Designed to withstand heavy ice and snow loads typical at high elevations.		Subject to being pushed and deformed by snow loads. GPS and telemetry antennas easily buried in winter months. Equipment cannot collect and transmit data once buried.	
Enclosure or Frame	500 lbs.	Plywood with fiberglass overwrap	250 lbs.	Aluminum box with stainless steel legs and post
Batteries	700 lbs.	Ten 70-pound batteries; recharge with solar panels; last 3 to 5 years	100 lbs.	Five 20-pound batteries; air-activated, non-renewable; last up to 1 year
Instruments	200 lbs.	Dual frequency GPS, seismic, radio, coax, conduit, wire	50 lbs.	Single frequency GPS, seismometer, radio, coax, wire

Measure	Fiberglass Enclosure		Spider	
Solar Panels	100 lbs.	4 mounted on enclosure, recharge batteries	0 lbs.	None
Anchor or footing	400 lbs.	1 bag concrete per corner, 2 or 3 bags for pipe	9 lbs.	18”x 3/4” rebar driven in ground at each leg
Total weight	1,900 lbs.		409 lbs.	
Tools				
Hand vs. motorized tools	Use of hand-portable battery-powered equipment or hand tools		Use of hand-portable battery-powered equipment or hand tools	
Ground disturbance				
Size	5 x 5 x 5-feet (enclosure) 7 to 8 feet tall (GPS)		5-feet (approximate span) 8-feet tall	
Ground mount	Ground flattened. Holes dug under each corner where a bag of concrete is mixed and a bolt is set to secure the enclosure.		To provide some stability, legs would be secured to the ground by digging a hole at each corner where concrete is mixed and a bolt is secured to each leg.	
Other ground disturbance	Seismic sensor is buried in ground approximately 2 to 3 feet deep and 6 to 10 inches wide.		Bury the seismic sensor in ground 2 to 3 feet deep and 8 to 10 inches wide.	
Area impacted	30 square feet		25 square feet	
Transportation				
Helicopter use[7]	At each site, 4 sling loads to deliver equipment and 1 sling load to back haul at end of day. One day of operations expected, but could stretch over two days. No passenger transport. Battery replacement (see below).		At each site, 2 sling loads to deliver and 1 sling load to backhaul at end of day. No passengers transported. Battery replacement (see below).	
Helicopter landings in wilderness	No helicopter landings would occur. Approximately 15 sling loads for installation; 4 sling loads for battery replacement (every 3 to 5 years)		No helicopter landings would occur. Approximately 9 sling loads for installation; 2 sling loads for each battery replacement (every year)	

[7] Based on medium-sized helicopter (i.e., Bell 2016)

Measure	Fiberglass Enclosure	Spider
Non-mechanized transportation	For each site, a crew of 2 to 3 people would hike in and camp out.	For each site, a crew of 2 to 3 people would hike in and camp out.
Annual maintenance	Crew of 2 people on foot	Crew of 2 people on foot
Battery Use and Replacement		
Energy source	Uses solar power to provide continuous power to all electronics throughout the year. Battery back-up; replaced every 3 to 5 years.	Battery powered; replaced every 9 to 12 months
Battery replacement	For each site, no more than 1 sling load with helicopter to bring in new batteries and remove old batteries. Less than one day of operations for helicopter. Crew of 2 to 3 people would hike in to each site. Camp overnight at 3 remote sites.	For each site, 2 sling loads with helicopter to bring in new batteries and remove old batteries. Crew of 2 to 3 people would hike in to each site. Camp overnight at 3 remote sites.

Appendix B: Cumulative Effects Information

This appendix provides more specific information in support of the cumulative effects analysis sections in Chapter 3 of this environmental assessment.

Definition

Cumulative impact is the impact on the environment that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor or collectively significant actions taking place over a period of time (40 CFR 1508.7).

Cumulative Effects Analysis

The environmental effects analysis documented in Chapter 3 was guided by the Forest Service CEQ Regulations at 36 CFR 220, and by Forest Service NEPA Handbook 1909.15. Section 15.1 of the Handbook, "Cumulative Effects," gives specific guidance on how to conduct a cumulative effects analysis. The 36 CFR 220.4 (f) regulation, "Cumulative Effects Considerations of Past Actions," gives agency direction on how to handle past actions in a cumulative effects analysis. It cites the June 24, 2005 memo, *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis*, Executive Office of the President, Council on Environmental Quality (Executive Office of the President, CEQ 2005

Briefly, the memo states that agencies are to use scoping to determine whether, and to what extent, information about the specific nature, design, or present effects of a past action is useful for the agency's analysis of effects of a proposed action and its reasonable alternatives. "Agencies are not required to list or analyze the effects of individual past actions unless such information is necessary to describe the cumulative effect of all past actions combined." The memo also notes that agencies can generally conduct an adequate cumulative effects analysis by focusing on the current aggregate (or remaining, residual) effects of past actions without delving into the historical details of past individual actions.

Table 8 below lists future actions within the vicinity of the USGS Seismic Monitoring project that may have effects that spatially and temporally overlap with the projected effects of the project. Future projects are listed first, followed by present ongoing projects, followed by past projects. The table is intended to be a screening mechanism for possible cumulative effects described in Chapter 3.

Table 8 - Past, Present, and Reasonably Foreseeable Future Actions

Activity	Extent	Timing/ Comment
Future Actions		
Future timber harvest on private and state lands	Extent is unknown, private and state timber lands to the west of the forest boundary.	On-going
Timber Stand Improvement	Precommercial thinning and release from hardwoods – matrix lands.	On-going
Campground/Rental Maintenance and hazard tree removal	Buck Creek and Sulphur Cr. campgrounds, Suiattle Guard Station.	Yearly, on-going
Road and Trail Maintenance	Road brushed every 3 years, grade/blade 2 times per year. Rock pit maintenance, Trail maintenance –yearly.	On-going
Invasive Plant Treatments	Treatment of known sites in the watershed.	On-going, minor short-term impacts from herbicides.
Road 2640 and 2643 Closure/Storage – Legacy Projects	Road 2640 road work? Decommission 3 miles of Road 2643	Contract in 2017. Short-term sediment with improved local hydrology.
2016 ERFO repairs - Tenas Creek	Road 2660 repair or treatment	Environmental assessment in 2017, treatment in 2018
Bull Bear Trail Construction	New trail (5.75 mi) construction from Rat Trap Pass to Skaar Pass	2018 or when funding is available
Road 2703 Treatment	Approximate 5 miles of road – upgrade or decommission	2018 or out year?
Milk Creek Bridge reconstruction	Bridge reconstruction over Suiattle River, and trail reconnection	2017 – planning and NEPA 2018 - construction
Green Mountain Trail reroute	Minor reroute of trail for resource protection	2017 or 2018
Mountain Goat Relocation	Multiple locations throughout the Forest	2018-2020
Grizzly Bear Restoration	Glacier Peak Wilderness	Possibly 2020, depending on completion of NEPA. Project may run for several years
USGS Core Sampling	Multiple locations within Glacier Peak Wilderness, four flight/year for four years	2019-2022
Snohomish County Sheriff SAR	Radio Maintenance, five locations involving one flight/year in Wilderness	2019-2039

Activity	Extent	Timing/ Comment
Present Actions		
Road maintenance	Routine road maintenance on open roads in the watershed.	On-going, Short-term sediment with maintained ditches.
Trail maintenance	Routine trail maintenance on accessible trails in watershed.	On-going, minor short-term sedimentation.
Pacific Crest Trail Maintenance	Helicopter supplies into remote section of PCT	2017
Invasive Plant Treatments	Treatment of identified sites in the watershed.	Minor short-term impacts from herbicides.
Campground Maintenance and hazard tree removal	Buck Creek and Sulphur Cr. campgrounds, Suiattle Guard Station.	Yearly, on-going
Deck sale on Road 25- (might be finished?)	Salvage of blowdown on road 25	Finalization of deck sale -(move to past projects if done)
Suiattle ATM: (Access & Travel Management) Plan	Decision to maintain 66 miles of roads as open, close 23 miles of road and decommission 51 miles of road.	2012 decision, implementation ongoing, Circle Creek Road 2703 need to upgrade or decommission
Downey Cr. Water Monitoring	Special Use permit for sensors installation at Downey cr. Bridge	Sept. 2016- Oct. 2017
Wetland restoration Monitoring – Rd 26	MP 6.0 and MP 13 – monitoring of sites on Suiattle River Rd. 26	2017-2022
Past Actions		
Suiattle - PCT repairs	New trail bridge over Suiattle and reconstruction of 2-3 mile of Pacific crest trail.	Completed 2011.
2006 ERFO Road Repair	Road 2660	Completed 2009.
USGS sediment sampling on Glacier Pk.	Special use permit for data gathering - helicopter materials	Completed 2016
Suiattle River Road 26 Project (WA FS ERFO 071-2023)	Repair eight sites along road 26.	2013-2015
Boundary Bridge Repair: Extend bridge to better span floodplain	Repair bridge across the Suiattle at 9.9 miles.	Completed in 2009. Some downstream sedimentation estimated, improve woody debris passage.

Activity	Extent	Timing/ Comment
Past Actions		
Join Ventures Road Work - 2008	Rd. 2661 – storage treatment Rd 2640 - Grade Creek storage	Completed in 2008. Completed in 2010.
Join Ventures Road Work - 2007	Grade and Big Creek road spur treatments – storage	Completed in 2008-2010.
Suiattle Trail Repairs	Trail relocation along first 2 miles of trail 784, and approach to PCT bridge.	Construction in 2006 to 2011. Minor short-term sediment, blasting, no habitat removal.
Marsh Pond Fish Passage Restoration:	Remove outdated fish ladder. Modify berm at outlet of marsh pond and outlet channel to improve fish passage.	2014-2015
Road 25 Closure/Storage	2.5 miles of waterbars and culvert removals in Rd. 25 Decommission of Lime Creek and Rd. 25 back to Circle Creek.	Completed in 2002. Minor short-term sediment with improved local hydrology.
Road 2540 Removal	Decommission first 1.23 miles after Marsh Pond treatment	2013-2015
Road 26 Captain Creek Culvert Replacements	Fish passage improvement at Captain and other creeks.	Completed 1998. Increased access to spawn/rearing habitat for coho. Short-term sediment with improved local hydrology.
Sulphur Creek Campground Renovation	Decommission sites adjacent to the Suiattle River. Construct new sites in the upland forested areas.	2014-2016
Suiattle Seed Orchard Revegetation	Revegetate 15 acres along the western edge of the Orchard, nearest the Suiattle River.	2014-2015
Non-Federal Land Timber Harvest:	Harvest west of MP 6.0. on Road 26	Harvest 2004-2009 – approximately 400 acres.
Legacy road decommissioning and storage	Road 2511 and 2512 implementation of Suiattle ATM.	On-going, short-term sediment.
Invasive Plant Treatments	Green Mt. Horse Pasture, along roads, and rock pits.	Minor short-term impacts from herbicides.

Activity	Extent	Timing/ Comment
Past Actions		
Instream Treatments	Structures and off-channel projects for spawning and rearing habitats in multiple streams, including Sulphur Creek.	Completed mid-1980s into early 1990s. Many have suffered effects from flooding events. Increased spawning and rearing. Short-term sediment and bedload.
Campground/Rental Maintenance	Buck Creek and Sulphur Cr. campgrounds, Suiattle Guard Station.	Minor short-term sediment
Historical Road Repairs	Multiple fixes from past floods in 1974, 79, 80, 89, 90 96. Replace fill and riprap, clear and replace with larger culverts along Roads 25, 26, other roads.	Short-term sediment with improved local hydrology and fish passage.
Trail Maintenance and Repair	Trail with maintenance work; Circle Peak, Huckleberry, Boulder Lake, Sulphur, Downey, Buck, Suiattle, Green Mtn.	Minor short-term sediment
Forest Service Timber Harvest	7810 acres total in WA – 2450 acres 1980 to 1995, 5360 acres 1930 to 1979 mostly by clearcut.	Sedimentation, changes in hydrology, removal of riparian vegetation and old growth habitat, reduction of instream wood.
2009 Green Mountain Lookout renovation	Work at Green Mountain peak and camping at adjacent areas for rehabilitation work.	Helicopter activity 2009-2010
Private Land	Approx. 13,000 acres in watershed	Primary activity is timber harvest, mostly western or lower portion of the watershed